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OF THE

STATE OF CONNECTICUT

VOL. III

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Printed by Order of the General Assembly

HARTFORD
1900

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State of Connecticut

PUBLIC DOCUMENT

FIFTEENTH ANNUAL REPORT

OF THE

Bureau of Labor Statistics

OF THE

State of Connecticut

FOR THE

YEAR ENDING SEPTEMBER 30, 1899

HARTFORD PRESS:
THE CASE, LOCKWOOD & BRAINARD COMPANY
1899

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STATE OF CONNECTICUT
OFFICE OF THE COMMISSIONER OF BUREAU OF
LABOR STATISTICS

LETTER OF TRANSMITTAL

HARTFORD, December 30, 1899.

To His Excellency,
GEORGE E. LOUNSBURY,
Governor of Connecticut.

SIR: As directed by law, I have the honor to present herein the Fifteenth Annual Report of the Bureau of Labor Statistics.

Very Respectfully,

HARRY E. BACK,
Commissioner.

INTRODUCTION.

In the present report are presented data and information regarding "private and municipal ownership of electric light and power plants, gas works, and water works," the "condition of manufactures," the establishment and operation of "free public employment offices," a complete "directory of labor organizations" and their officers, and a compilation of the "labor laws of this state." In the part of the report dealing with municipal ownership of electric, gas, and water works, this bureau has been aided, in the collection of statistics, by the United States Department of Labor, which is conducting a similar investigation in every state of the Union. The statistics regarding the condition of manufactures in this state were collected by this bureau, with the help of the manufacturers. The information regarding the free public employment offices was secured from the labor bureaus of those states which have established such institutions. The directory of labor organizations, with their officers, was secured by this bureau assisted by those organizations. The labor laws were arranged, also, by this bureau to fill a very general demand from citizens of Connecticut.

MUNICIPAL OWNERSHIP.

The investigation of municipal ownership of electric, gas, and water companies has been undertaken for the purpose of giving information to that increasing number that is becoming interested in discussing the advisability of municipalities not only governing themselves, but also, to some extent, entering into business and

providing certain things for themselves and their inhabitants. Let it be understood from the start that this bureau does not "take sides" in this discussion. It here presents the facts that students of the problem, be they in favor of or against it, may have reliable data from which to study the problem and reach conclusions. The discussion of municipal ownership not only usually embraces electric, gas, and water plants, but also street railway companies. This bureau has not attempted to present any information regarding the street railways of Connecticut for the reason that the Hon. Railroad Commissioners of the state give statistics regarding such corporations, annually, and the students of municipal ownership may find the desired data in their excellent report.

In looking into the condition of the electric, gas, and water plants, the same mode of investigation has been employed for each. The information of every one of the three classes of industries has been grouped under the following heads: "Plant, Distributing Equipment, and Apparatus Owned;" "Fuel Conditions and Water Supply;" "Investment;" "Gross Income;" "Cost of Production;" "Result of Operation;" "Profit and Loss," and "Prices and Cost of Production." There were no municipally owned gas works found in the state, but cities, boroughs, and towns do furnish their own electricity and water in certain instances, and so in those two divisions the following additional tables are presented: "Sources of Funds Used in the Investment of Municipally Owned Plants;" "Distribution of Cost of Production of Municipal Plants" and "Certain Additional Elements Theoretically Entering into the Cost in Municipally Owned Plants."

There is a value to these tables and the analyses thereof, in addition to the interest and information which they may have for the student of "municipal ownership." They rightfully may claim a place in a report of a labor bureau, for they do present the facts regarding the amount of capital invested in a certain line of enterprises, because they give information relating to the operation of those enterprises, and especially for the reason that

they tell of the amount of labor that it takes to deliver electricity, gas, and water to a community. It appears that the labor that goes into the furnishing of electricity is about 25 per cent. of the cost of production, while in the case of gas it is about 18 per cent. thereof, and in providing water, as nearly as can be estimated, it is about 10 per cent. thereof. Of course these proportions are all given for the running of the plants after they have been constructed. But in the original constructions a very much larger percentage of labor has to be employed. It is also a patent fact that once in a term of years all gas and water pipes have to be renewed and electric wires have to be strung again so that the laborer must, from the nature of the case, ever receive no little employment from this class of industries. Then, too, these percentages of labor are only the amounts paid in "wages" and are exclusive of salaries, while many employes, in addition thereto, who are truly laborers, receive fixed salaries.

Again, the information given in regard to these three groups of plants must possess value for those whose capital is invested in such establishments and for those who are managing similar works. This is so, for it is shown how much capital is used to produce certain results, incomes, profits, etc., in the several cases, and how much it costs to operate the various parts of each establishment. For instance, it may be seen that anthracite coal costs the numerous plants prices varying from $3.30 to $4.46 per ton, and the bituminous coal from $1.88 to $4.69. It would be still more interesting if the location of each plant could be given, thus demonstrating what locations are most favorable: but this bureau has to destroy, as far as possible, all tell-tale marks that might disclose the identity of the establishments herein reported. In truth, the bureau possesses statistics from many more establishments which it is not permitted to publish. Those given, however, represent the average, and are sufficient from which to draw conclusions. Owners and managers of electric, gas, and water works will find a study of these tables interesting.

Only one municipally owned electric lighting plant in this state was reported for the year covered by this investigation.

Another, however, now is in process of construction, and is just entering upon its operation in Wallingford. Is electricity to supercede gas for lighting purposes? will be a pertinent and important inquiry for every municipality to make before purchasing any gas works in these times of electrical development and improvement. True it is that Connecticut cities, towns, and boroughs never have taken kindly to public ownership of gas works. The attention of students of municipal ownership is especially called to the tables dealing with "certain additional elements theoretically entering into municipally owned plants." It may be seen that there is a loss in taxes, sewer assessments, sidewalk assessments, etc., which would come into the public treasury were municipal plants owned privately.

The water famine existing in many Connecticut cities and towns, at the time of going to press with this report, emphasizes the necessity of increasing the sources of supply of the various water works. When the gas statistics were collected, the experiment of "dollar gas" had not been tried in Connecticut. Now, for many months, however, gas at one dollar per thousand feet has obtained in Hartford. The result has been the same in the capital city as elsewhere under the same condition. The consumer pays as large a gas bill as formerly, for he uses more gas when it is cheap. The advantage comes in his securing more light for his money. With these introductory remarks, the reader is respectfully referred to the part of this report, upon page 17, dealing with private and municipal ownership of public utilities.

CONDITION OF MANUFACTURES.

The part of the report dealing with the condition of manufactures is practically a continuation of similar investigations by this bureau during the four preceding years. As a source of information regarding the industrial situation in this state, both as affecting employer and employe, it is very valuable. When compared with the results of similar investigations made during the four years last past, it is interesting. It shows that the wave

of prosperity which has swept over the State of Connecticut during the closing days of the year 1899, was well upon its way on July 1st, but the present prosperous conditions, realized and felt by all, demonstrate that the wave, as rolling onward on July 1st, since has been greatly augmented and increased.

Connecticut industries are so widely diversified, so ingenious, and so spread out over the entire state, that they are the pride of her citizens and the wonder of the world. Therefore, it results that in this state, covering but a limited area, the bureau, in classifying the industries, has had to group them under the following many divisions, each one of which embraces even more largely numerous products: "Brass and Brass Goods," "Carriages and Carriage Parts," "Corsets," "Cotton Goods," "Cotton Mills," "Cutlery and Tools," "General Hardware," "Hats and Caps," "Hosiery and Knit Goods," "Iron and Iron Foundries," "Leather Goods," "Machine Shops," "Musical Instruments and Parts," "Paper and Paper Goods," "Rubber Goods," "Shoes," "Silk Goods," "Silver and Plated Ware," "Stone Cutting and Quarrying," "Wire and Wire Goods," "Wood Working," "Woolens and Woolen Mills," and "Miscellaneous." Six hundred and sixty-eight establishments reported to the bureau their conditions, this year. These embraced practically all of the larger manufactories of the state in operation on July 1st, and many of the smaller ones. It should be stated, however, that numerous other concerns which reported to this office, upon July 1st, that they were not in operation, have since resumed work, until now such a condition of prosperity exists here that a person not desirous of laboring has to work hard to escape from being drawn into some form of business.

These six hundred and sixty-eight establishments upon July 1, 1899, employed 97,922 men and women. These employes represent, according to the usual ratio, families which depend upon them for subsistence, containing about 391,688 members. The total population of the state by the census of 1890 was 746,258, and taking into consideration the great number of persons employed in mercantile, commercial, financial, agricultural, and

other pursuits than industrial, it is evident that the major part of the industrial laborers are included in this report. The amount reported as being paid in wages covered an entire year ending July 1, 1899. Now the prosperity in Connecticut had for the most part come between January 1 and July 1, 1899, so that, relatively, the amount paid in wages could not show so great an increase as the number employed; for it will be seen that all those employed on July 1, 1899, had not been drawing wages during the entire year. Nevertheless, with the figures as they are, it appears that the average yearly wages received by each of the 97,922 employes reported were $420.04, while the average yearly amount for each person who had to be supported by those employes was about $105.01. However, for the reason stated just above, the actual wages and the amount for the support of each person must have been considerably above the figures here given.

Nor does the above reveal all of the bright side of industrial Connecticut at the close of the year 1899. Reports from about 75 of the mill towns of Connecticut show that since July 1st not only has there been an increase in the amount of manufacturing done, an addition to the number employed, but also advances of from 6 to 12 per cent. in the wages paid, especially in cotton and woolen mills. These with prior advances, made within one year, make increases in cotton mills especially of from 12 to 20 per cent. since the last report of this bureau was issued. However, it should be stated here, that these increases in wages are but restorations toward the high wages paid in 1892. It is stated, also, by many manufacturers of woolen and cotton goods, that looms, for which work is ready, are idle because operatives cannot be found. The real results of the industrial prosperity have not been fully realized yet, again, because during the past long period of financial depression many, very many persons were obliged to run into debt and now are paying off those obligations, but when the old liabilities are canceled the laborers can fully enjoy the fruits of their labor in a period of prosperity. The condition of manufactures and industrial statistics may be found

by the reader upon page 91 and the forty-three succeeding pages.

FREE PUBLIC EMPLOYMENT OFFICES.

That 'one-half the world does not know how the other half lives' is a fact well established and undisputed to-day. That the people of this state, who do not have to apply for positions by which to earn their daily bread at the doors of private, selfish employment offices, are not acquainted with the hardships that are experienced by those who are compelled to seek employment in such a manner is a striking illustration of the sentiment first above quoted. It is a patent fact that those who conduct private employment offices are doing it for their own gain and not for the good of those whom they pretend to serve. This, in itself, would not be very improper or wrong were it not for the fact that such private employment agencies seek to realize their income and profit from a most unfortunate class and one that needs sympathy and assistance, and is in no condition to protect itself or to be plundered, viz.: a class of unemployed that needs, desires, and patiently seeks employment.

By establishing free public employment agencies, the state can come to the rescue of this class of unfortunates, with very little expense to itself. In fact, the expenditure would be saved many times over to the state by decreasing the sums it has to pay in care of vagrants, by lessening the amounts that towns are taxed for paupers who cannot find employment, and by taking away the necessity for so much expenditure in private charities. Ever since it was decreed that 'by the sweat of his brow man should earn his bread,' labor has been a divinely given privilege and universal right, and idleness has been a hardship. But private employment agencies have taxed persons for their privilege of laboring, and have even, in too many cases, taken their little remaining savings without furnishing them the desired work. These parasitic private offices which prey upon the unfortunate and take the little they have in consideration for a promise to secure what, perhaps, they can give, but what, in more

instances, they do not give, could no longer work their plundering if public offices were established. Their business would be taken away and they would be compelled to seek other occupations.

The free public employment office would be a boon to the employer as well as the employed. Applications for positions and applications for help would be made to the same impartial, unselfish office from all over the state, and the two needy classes would be brought together to their mutual benefit. Such offices are no longer experiments in any way. That they may be conducted successfully, practically, with great benefit and without any heavy or noticeable expense, repeatedly has been demonstrated in this country. Especially has this been shown in Chicago, Cincinnati, Cleveland, Toledo, Columbus, and Dayton, as the mayors and other officials of those cities repeatedly have testified. An examination of the portion of this report (from page 137 to page 170), treating of free public employment agencies, will establish these assertions.

The report, proper, follows:

Part I

Private and Municipal Ownership

1 ELECTRIC LIGHT AND POWER PLANTS

2 GAS WORKS

3 WATER WORKS

PRIVATE AND MUNICIPAL OWNERSHIP OF ELECTRIC LIGHT AND POWER PLANTS, GAS WORKS AND WATER WORKS.

The growth of municipal ownership of certain public utilities in the cities of England has been marked in recent years. Indeed, municipal enterprise along this line has developed more rapidly across the water than here, with the result that American students of political and social economy now are studying the workings of such management in the cities across the sea. There have been found good reasons for and against such control. The friends of the movement claim its superiority and desirability in the fact that, under municipal control, certain necessities are furnished the inhabitants of the cities by a management which is not conducted for the private greed or gain of capitalists, but by an administration which directs affairs in an unselfish spirit and seeks to accomplish the greatest good for the greatest number. The opposition to such ownership by American cities brings forth the argument that municipalities here now have all that they can do to govern themselves properly without reaching out and, already overburdened, taking unto themselves a greater load to carry and to stagger under. They also say that there is no more call for public control of the furnishing of light, water, power, and transportation than there is for the furnishing of fuel, food, wearing apparel, and all the necessities and, indeed, comforts of life.

This Bureau has no intention or desire to take part in any discussion for or against a policy of municipalities reaching out along the lines of such ownership. It now presents, in connection with the United States Department of Labor and the bureaus of the several states, such statistics as could be secured

which might be of benefit to those interested in the study of municipal ownership. These data have been gathered in connection with the furnishing of light and water to the people.

It is patent to all that, inasmuch as, in the large majority of instances, light and water are furnished to the cities of Connecticut by private agencies, and inasmuch as the bureaus have not power to force the giving of information, it is with difficulty that facts and conditions affecting private interests are secured. Nevertheless, fifty-seven plants in all, from various sections of the State, have given the desired data. The statistics given are reliable and furnish a sound basis for study, inasmuch as they are from representative plants, and their average presents a fair average for the State.

The statistics gathered will be treated under three heads or classes, viz.: Electric Lighting Plants, Gas Works, and Water Works. Fourteen electric lighting plants reported, and of these only one was under municipal ownership. Nine gas works responded, all of which are under private control. Thirty-four water works replied, and of these twenty-two are under private management and twelve under municipal control. It is apparent that every one of these concerns are doing business at a good profit, although some of them figure a loss. This loss is a forced showing, in the instances where it appears, because of the large amounts charged up to maintenance under the claim of "estimated depreciation" of the plant; and, indeed, the profits are actually much larger than are herein shown, because of the amount, even in those plants showing a profit, there too charged off for "estimated depreciation."

ELECTRIC LIGHT AND POWER PLANTS.

The statistics concerning the electric lighting plants are given in the ten tables below. The data given in each table are as follows:

Table I, "Plant, Distribution, Circuits, and Apparatus Owned;" Table II, "Fuel Conditions and Water Supply;" Table III, "Investment;" Table IV, "Sources of Funds Used

in the Investment;" Table V, "Gross Income;" Table VI, "Cost of Production;" Table VII, "Distribution of Cost of Production of Municipal Plant;" Table VIII, "Certain Additional Elements Theoretically Entering into the Cost in Municipally Owned Plants;" Table IX, "Profit and Loss of Private Plants;" Table X, "Prices and Cost of Production of Light and Power Service."

The facts and information given are for one year, unless the respective table or heading otherwise specifies. The year covered in each instance was the fiscal year of the several establishments corresponding nearest to the year from January 1, 1897, to January 1, 1898.

Although only one establishment out of those reporting was a municipal plant, and although, too, that was the only municipal electric plant then operating in this State, it may be of interest to know that there since have been established other electric lighting concerns by cities, boroughs, and towns in the State, and that at present others are in the process of construction.

To those interested in labor and the part it has in production, Table VI will prove especially interesting. That table shows that, on the average, the labor that goes into the production of electricity, after an outfit is completed, amounts to about one-fourth of the cost of production. In other words, in proportion to the cost of production, wages appear to amount from 14.36 to 37.09 per cent.

The advantages or disadvantages that may result to municipalities by owning and operating their own electric lighting paraphernalia may be especially studied in Table X. Evident it is from that table that municipalities are securing their own lighting so cheaply that nothing worth while would be saved to their respective public treasuries by municipal ownership. On the other hand, however, municipal control might result in greatly reduced prices to private users. The tables follow.

TABLE I. ELECTRIC LIGHT, ETC., PLANTS: PLANT, PRIVATE AND

Plant Number.	Ownership.	Years constructed.	Present ownership dates from.	Steam Power Plant.				Water power plant water wheels.		Electric Power Plant.					
				Engines.		Boilers.				Direct current constant voltage dynamos.		Direct current constant amperage dynamos.		Alternating and multiphase current dynamos.	
				Number.	Total rated capacity H. P.	Number.	Total rated capacity H. P.	Number.	Total rated capacity H. P.	Number.	Total kilowatt capacity.	Number.	Total kilowatt capacity.	Number.	Total kilowatt capacity.
1	Private.	1891	1891	1	100	1	150	....	.....	2	40	....	.....	....	.....
2	Municipal.	1892	1892	1	100	1	125	....	.....	....	.....	2	58 8/10	....	.....
3	Private.	1887	1887	1	125	2	205	....	.....	2	52 8/10	1	9 1/2	....	.....
4	Private.	1887	1891	1	150	1	150	....	.....	6	44 3/10	....	.....	1	22
5	Private.	1890	1890	....	.....	....	.....	2	185	....	.....	1	10	1	35
6	Private.	1886	1886	2	200	3	240	1	60	....	.....	....	.....	3	194
7	Private.	1890	1890	2	310	2	190	....	.....	....	.....	2	30	3	157
8	Private.	1890	1890	1	140	1	100	1	175	....	.....	....	.....	2	90
9	Private.	1895	1895	2	400	2	200	....	.....	....	.....	1	19	2	200
10	Private.	1884	1884	1	175	2	170	4	240	1	170	....	.....	1	70
11	Private.	1887	1887	5	550	3	450	....	.....	4	120	7	140	....	.....
12	Private.	1885	1885	2	520	3	375	2	340	3	475	7	114	3	135
13	Private.	1886	1886	3	925	3	360	....	.....	1	90	6	132	3	305
14	Private.	1890	1893	3	1,200	4	800	....	.....	....	.....	6	335	5	435

DISTRIBUTION CIRCUITS, AND APPARATUS OWNED.

MUNICIPAL PLANTS.

Line Construction.						Transformers.			Lamps connected.		Total H. P. of stationary motors connected.	Plant Number.
Main Wires.		Feeder Wires.		Miles of street served.								
Length in miles.	Weight of copper, pounds.	Length in miles.	Weight of copper, pounds.	From underground lines.	From aerial lines.	Number.	Voltage of primary current.	Total output capacity in watts.	Arc.	Incandescent.		
3.00	3,900	1.50	2,000	.....	3.00	.....	.....	.....	38	1,000	.....	1
15.10	8,858	.....	.....	.....	15.00	.....	.....	.....	101	.....	.....	2
13.08	8,044	2.60	3,050	.....	3.00	.....	.....	.....	30	750	.....	3
23.00	12,144	.....	.....	.....	9.50	25	1,000	15,000	128	500	.....	4
*a*30.00	*a*7,542	*b*	*b*	.....	4.00	50	1,000	32,500	30	700	.....	5
45.00	31,000	4.00	4,200	.....	6.50	84	1,000	109,250	.....	2,746	.....	6
45.50	25,650	5.00	6,740	.....	45.00	133	1,040	252,900	86	5,178	.....	7
4.00	4,000	1.00	1,000	.....	2.00	65	1,000	90,250	.....	2,700	.....	8
50.00	36,385	.....	.....	.....	10.00	63	2,080	134,350	32	2,541	.....	9
4.00	3,280	.....	.....	.....	1.00	20	1,000	40,500	23	810	.....	10
132.36	58,771	12.30	34,243	.....	50.00	.....	.....	.....	288	1,500	8	11
83.44	75,359	14.56	51,057	.....	20.02	67	1,000	129,500	250	1,464	566⅙	12
100.00	73,130	.....	.....	.....	28.00	63	1,040	180,000	215	4,092	45¼	13
60.00	25,000	20.00	14,000	.....	20.00	150	1,040	210,000	200	6,202	8	14

a Including feeder wires. *b* Included in main wires.

TABLE II. ELECTRIC LIGHT, ETC., PLANTS: FUEL CONDITIONS AND WATER SUPPLY.

PRIVATE AND MUNICIPAL PLANTS.

Plant Number.	Ownership.	Fuel.					Water supply, cost per year.	Water-power purchased.	
		Coal.		Other.					
		Kind.	Cost per 2,000 lbs.	Kind.	Unit of price.	Cost per unit.		Quantity H. P.	Cost per H. P.
1	Private.	Bituminous.	$3.52	.....	.....	.....	.....	.....	.....
2	Municipal.	Bituminous. *a*	2.56	.....	.....	.....	$50.00	.....	.....
3	Private.	Bituminous.	*b*	.....	.....	.....	.....	.....	.....
4	Private.	Bituminous.	3.30	.....	.....	.....	25.00	.....	.....
5	Private.	.....	.....	.....	.....	.....	.....	100	$8.00
	Private.	Bituminous.	4.02	.....	.....	.....	.....	60	7.50
7	Private.	Bituminous.	2.68	.....	.....	.....	300.00	.....	.....
8	Private.	Bituminous.	4.46	.....	.....	.....	.....	175	4.86
9	Private.	Bituminous.	2.95	.....	.....	.....	.....	.....	.....
10	Private.	Bituminous.	3.57	.....	.....	.....	.....	.....	.....
11	Private.	Bituminous.	3.35	.....	.....	.....	427.00	.....	.....
12	Private.	Bituminous.	3.39	Coke and culm.		*c*	63.00	340	5.88
13	Private.	Bituminous.	1.88	Coke.	Bushel.	$0.08	528.00	.....	.....
14	Private.	Bituminous.	2.76	.....	.....	.....	900.00	.....	.....

a Also Culm. *b* $4.02 and $2.23. *c* Not reported.

TABLE III. ELECTRIC LIGHT, ETC., PLANTS: INVESTMENT.

PRIVATE AND MUNICIPAL PLANTS.

Plant Number.	Ownership.	Land.		Buildings.		Steam or water power plant.		Electric power plant.		Distributing circuits, lamps and apparatus.		Total investment.
		Cost.	Per cent. of total investment.	Cost.	Per cent. of total investment.	Cost.	Per cent. of total investment.	Cost.	Per cent. of total investment.	Cost.	Per cent. of total investment.	
1	Private.	$500	2.85	$2,646	15.11	$4,661	26.62	$7,000	39.97	$2,705	15.45	$17,512
2	Municipal.	2,000	10.00	4,118	20.59	4,285	21.42	*a* 9,597	*b*	*c*	*d*	20,000
3	Private.	300	1.50	1,016	5.08	4,329	21.64	9,265	46.33	5,090	25.45	20,000
4	Private.	600	.73	10,000	12.12	10,000	12.12	47,000	56.97	14,900	18.06	82,500
5	Private.	250	.87	2,000	6.97	11,250	39.20	1,700	5.92	13,500	47.04	28,700
6	Private.	*e*	*e*	*e*	*e*	4,500	22.50	5,500	27.50	10,000	50.00	20,000
7	Private.	5,000	4.35	15,000	13.04	20,000	17.39	25,000	21.74	50,000	43.48	115,000
8	Private.	8,000	15.42	4,000	7.71	13,000	25.07	22,000	42.42	4,867	9.38	51,867
9	Private.	450	.71	7,500	11.91	15,500	24.60	11,550	18.33	28,000	44.45	63,000
10	Private.	4,000	11.11	4,000	11.11	15,000	41.67	6,000	16.67	7,000	19.44	36,000
11	Private.	*e*	*e*	*e*	*e*	10,526	17.82	27,882	47.20	20,667	34.98	59,075
12	Private.	*f*	*f*	25,000	16.51	39,750	26.25	43,950	29.03	42,709	28.21	151,409
13	Private.	10,626	6.72	13,000	8.23	42,233	26.73	36,161	22.88	56,000	35.44	158,020
14	Private.	28,500	11.73	55,000	22.63	85,500	35.19	41,000	16.87	33,000	13.58	243,000

a Including cost of distributing circuits, lamps and apparatus. *b* Not obtainable for reasons stated in note *a*. *c* Included in cost of electric power plant. *d* Not obtainable for reasons stated in note *c*. *e* Land and buildings leased. *f* Land donated.

TABLE IV. ELECTRIC LIGHT, ETC., PLANTS: SOURCES OF FUNDS USED IN THE INVESTMENT.

MUNICIPAL PLANTS.

Plant Number.	Total investment.	Amount Derived From.			Bonds.					
		Taxation.	Transfers from funds on hand.	Issues of bonds.	Total amount outstanding.	Date of		Rate per cent. of interest.	Coin or gold.	Amount per $100 par realized from sale.
						Issue.	Maturity.			
2	$20,000.	.....	.....	*a* $22,500	$22,500	1893	1923	4	Gold.	*b*

a Including bonds issued for other purposes. *b* Not reported.

TABLE V. ELECTRIC LIGHT, ETC., PLANTS: PRIVATE AND

Plant Number.	Ownership.	From Lighting.					
		Arc service.		Incandescent service.		Total.	
		Amount.	Per cent. of total gross income.	Amount.	Per cent. of total gross income.	Amount.	Per cent. of total gross income.
1	Private.	$3,040	48.72	$3,200	51.28	$6,240	100.00
2	Municipal.	.....	.....	.....	.....	.....	.....
3	Private.	1,950	33.36	3,896	66.64	5,846	100.00
4	Private.	10,438	74.36	3,600	25.64	14,038	100.00
5	Private.	2,100	33.69	4,134	66.31	6,234	100.00
6	Private.	.....	.....	17,416	98.91	17,416	98.91
7	Private.	8,910	34.71	15,621	60.85	24,531	95.56
8	Private.	.....	.....	7,115	100.00	7,115	100.00
9	Private.	2,535	25.35	7,465	74.65	10,000	100.00
10	Private.	1,932	26.00	5,500	74.00	7,432	100.00
11	Private.	24,600	77.85	6,755	21.38	31,355	99.23
12	Private.	13,654	42.63	10,862	33.91	24,516	76.54
13	Private.	14,271	38.69	*a* 19,785	*b*	34,056	92.34
14	Private.	22,351	51.78	20,096	46.55	42,447	98 33

a Including income from fans. *b* Not obtainable for reasons stated in note *a*.

GROSS INCOME.

MUNICIPAL PLANTS.

From stationary motor service.		From all other sources.		Total gross income.	Plant Number.
Amount.	Per cent. of total gross income.	Amount.	Per cent. of total gross income.		
.....	.....	.....	.....	$6,240	1
.....	.....	.....	.....	.....	2
.....	.....	.....	.....	5,846	3
.....	.....	.....	.....	14,038	4
.....	.....	.....	.....	6,234	5
.....	.....	$192	1.09	17,608	6
.....	.....	1,141	4.44	25,672	7
.....	.....	.....	.....	7,115	8
.....	.....	.....	.....	10,000	9
.....	.....	.....	.....	7,432	10
$245	0.77	.....	.....	31,600	11
4,945	15.44	2,567	8.02	32,028	12
c 2,410	*d*	415	1.13	36,881	13
720	1.67	.....	.....	43,167	14

c Income from fans included in incandescent lighting service.
d Not obtainable for reasons stated in note *c*.

TABLE VI. ELECTRIC LIGHT, ETC., PRIVATE AND MUNICI-

Plant Number.	Ownership.	Report for the year ending	General Expenses.							Wages.	
			Salaries of officers, superintendents, clerks, etc.	Office supplies and expenses.	Insurance.	Legal expenses and damages.	Other.	Total.	Per cent. of total manufacturing cost of production.	Total.	Per cent. of total manufacturing cost of production.
1	Private.	June 30, 1897.	$1,000	$106	$71	.....	$34	$1,211	$19.59	$1.700	27.49
2	Municipal.	Oct. 12, 1897.	900	70	100	.....	.....	1,070	24.15	1,520	34.30
3	Private.	Sept. 30, 1897.	240	20	396	.....	.....	656	13.02	1,431	28.40
4	Private.	Jan. 1, 1898.	1,600	255	112	$50	.....	2,017	16.05	2,400	19.09
5	Private.	Dec. 31, 1897.	*b* 1,290	142	30	.....	1,152	*b* 2,614	*c*	*d*	*e*
6	Private.	Dec. 31, 1897.	2,000	160	118	2,000	1,050	5,328	36.44	2,100	14.36
7	Private.	Dec. 1, 1897.	1,828	355	275	100	.....	2,558	13.31	4,680	24.36
8	Private.	March 31, 1897.	560	50	.....	.....	150	760	14.88	1,895	37.09
9	Private.	Dec. 31, 1897.	1,236	100	104	.....	200	1,640	15.87	1,696	16.41
10	Private.	Oct. 31, 1897.	1,000	63	85	.....	200	1,348	23.38	1,011	17.53
11	Private.	Dec. 31, 1897.	2,486	683	275	50	1,200	4,694	18.03	8,587	32.99
12	Private.	April 1, 1897.	1,800	400	684	.....	.....	2,884	10.82	7,968	29.89
13	Private.	Dec. 31, 1896.	4,720	1,512	163	3	.....	6,398	20.44	5,762	18.41
14	Private.	Dec. 31, 1897.	2,400	685	850	690	.....	4,625	11.77	8,890	22.61

a Not reported.
b Including wages.
c Not obtainable for reasons stated in note *b*.
d Included in salaries of officers, superintendents, clerks, etc.
e Not obtainable for reasons stated in note *d*.
f Including $800 paid for water-power.
g Not obtainable for reasons stated in note *f*.

PLANTS : COST OF PRODUCTION.

PAL PLANTS (First Part).

Supplies.						Maintenance.											
						Actual disbursements for repairs and renewals.											
						On buildings.		On steam power plant.		On electric power plant.		On distributing circuits, lamps, and apparatus.			Total.		
Fuel.	Power-house supplies.	Lamp supplies.	Other.	Total.	Per cent. of total manufacturing cost of production.	Total.	Per cent. of cost.	Total.	Per cent. of cost.	Total.	Per cent. of cost.	Total.	Per cent. of cost.	Other.	Amount.	Per cent. of total investment exclusive of land.	Plant Number.
$1,184	$96	144	$602	$2,026	32.77	*a*	*a*	*a*	*a*	*a*	*a*	*a*	*a*	*a*	$200	$1.18	1
617	117	275	23	1,032	23.29	*a*	*a*	*a*	*a*	*a*	*a*	*a*	*a*	*a*	89	.49	2
1,075	61	176	89	1,401	27.81	.....	.....	.....	.....	.....	.....	$43	.84	$113	156	.79	3
1,480	97	404	25	2,066	16.44	.....	.....	.....	....	$70	.15	500	3.36	35	605	.74	4
.....	27	161	200	*f* 1,188	*g*	$17	.85	.....	.....	25	1.47	225	1.67	....	267	.94	5
3,330	130	900	30	*h* 4,840	*i*	.....	.....	$150	3.33	150	2.73	702	7.02	....	1,002	*j*	6
2,103	520	308	....	2,931	15.26	.....	.....	275	1.38	15	.06	682	1.36	21	993	.90	7
200	23	.....	....	*k* 1,073	*l*	.....	.....	15	.12	10	.05	184	3.78	10	219	.50	8
1,799	140	370	....	2,309	22.34	50	.67	350	2.26	75	.65	250	.89	....	725	1.16	9
300	82	363	25	770	13.35	.....	.....	495	3.30	200	3.33	425	6.07	50	1,170	3.66	10
5,625	807	1,467	50	7,949	30.54	.....	.....	175	1.66	425	1.52	125	.60	....	725	*j*	11
1,000	263	795	....	*m* 4,058	*n*	.....	.....	.....	.....	800	1.82	571	1.34	544	1,915	1.26	12
5,626	837	688	225	7,376	23.56	123	.95	955	2.26	162	.45	1,910	3.41	742	3,892	2.64	13
6,180	1,980	2,150	470	10,780	27.42	.....	... .	180	.21	730	1.78	850	2.58	....	1,760	.82	14

h Including $450 paid for water-power.
i Not obtainable for reasons stated in note *h*.
j Not obtainable : total investment exclusive of land not reported.
k Including $850 paid for water-power.
l Not obtainable for reasons stated in note *k*.
m Including $2,000 paid for water-power.
n Not obtainable for reasons stated in note *m*.

TABLE VI. ELECTRIC LIGHT, ETC.,

PRIVATE AND MUNICIPAL

Plant Number.	Ownership.	Maintenance Concluded.												
		Estimated Depreciation.												
		On buildings.		On steam power plant.		On electric power plant.		On distributing circuits, lamps, and apparatus.		Total.		Total.		
		Total.	Per cent. of cost.	Total.	Per cent. of cost.	Total.	Per cent. of cost.	Total.	Per cent. of cost.	Amount.	Per cent. of total investment exclusive of land.	Amount.	Per cent. of total investment exclusive of land.	Per cent. of total cost of production.
1	Private.	$53	2.00	$233	5 00	$490	7.00	$270	9.98	$1,046	6.15	1,246	7.32	20.15
2	Municipal.	*a*	*a*	*a*	*a*	*a*	*a*	*a*	*a*	720	4.00	809	4.49	18.26
3	Private.	20	1.97	216	4.99	649	7.00	509	10.00	1.394	7.08	1,550	7.87	30.77
4	Private.	200	2.00	500	5.00	3,290	7.00	1,490	10.00	5,480	6.69	6,085	7.43	48.42
5	Private.	40	2.00	563	5.00	85	5.00	675	5.00	1,363	4.79	1,630	5.73	30.01
6	Private.	.....	.....	240	5.33	110	2.00	1,000	10.00	1,350	*b*	2,352	*b*	16.09
7	Private.	300	2.00	1,000	5.00	1,750	7.00	5,000	10.00	8,050	7.32	9 043	8.22	47.07
8	Private.	40	1.00	195	1.50	440	2.00	487	10.01	1,162	2.65	1,381	3.15	27.03
9	Private.	75	1.00	745	4.81	346	3.00	2,800	10.00	3,966	6.34	4,691	7.50	45 38
10	Private.	80	2 00	568	3.79	120	2.00	700	10.00	1,468	4.59	2,638	8.24	45.74
11	Private.	.....	.....	526	5.00	1,882	6.75	1,667	8.07	4,075	*b*	4,800	*b*	18.44
12	Private.	500	2.00	1,987	5.00	3,077	7.00	4,271	10.00	9,835	6.50	11,750	7 76	44.07
13	Private.	130	1.00	1,421	3.36	723	2.00	5,600	10.00	7,874	5.34	11,766	7.98	37.59
14	Private.	1,100	2.00	5,985	7.00	2,870	7.00	3,300	10.00	13,255	6.18	15,015	7.00	38.20

a Not reported. *b* Not obtainable; total investment, exclusive of land, not reported.

PLANTS: COST OF PRODUCTION.

PLANTS (SECOND PART).

Total Cost of Production.		Taxes.	Total Cost of Production and Taxes.		Plant number.
Including estimated depreciation.	Excluding estimated depreciation.		Including estimated depreciation.	Excluding estimated depreciation.	
$6,183	$5,137	$90	$6,273	$5,227	1
4,431	3,711	.....	4,431	3,711	2
5,038	3,644	150	5,188	3,794	3
12,568	7,088	57	12,625	7,145	4
5,432	4,069	114	5,546	4,183	5
14,620	13,270	140	14,760	13.410	6
19,212	11,162	192	19,404	11,354	7
5,109	3,947	113	5,222	4,060	8
10,336	6,370	488	10,824	6,858	9
5,767	4,299	60	5,827	4,359	10
26,030	21,955	530	26,560	22,485	11
26,660	16 825	600	27,260	17,425	12
31,302	23.428	820	32,122	24,248	13
39,310	26,055	1,650	40,960	27,705	14

TABLE VII. ELECTRIC LIGHT, ETC., PLANTS: DISTRIBUTION OF COST OF PRODUCTION.

MUNICIPAL PLANTS.

Plant Number.	Total cost of production (including depreciation).	Income from private users.	Result to the city.	
			Cost.	Profit.
2	$4,431	....	$4,431	.....

TABLE VIII. ELECTRIC LIGHT, ETC., PLANTS:

Certain additional elements theoretically entering into the cost in municipally owned plants.

Plant Number.	Estimated rental value of the quarters occupied rent free.	Estimated taxes.	Interest on total investment.	Total additional cost.	Additional Cost per Unit.	
					Arc lighting per kilowatt hour.	
					Maximum.	Minimum.
2	.....	$125	$800	$925	$0.0096	$0.0096

TABLE IX. ELECTRIC LIGHT, ETC., PLANTS: PROFIT AND LOSS.

PRIVATE PLANTS.

Plant Number.	Report for the year ending	Gross Income.							Total cost of production including depreciation and taxes.	Net profit.			Net loss.
		From public service.		From commercial service.		From all other sources.		Total.		Amount.	Per cent. of gross income.	Per cent. of total investment.	
		Amount.	Per cent. of total gross income.	Amount.	Per cent. of total gross income.	Amount.	Per cent. of total gross income.						
1	June 30, 1897	$3,040	48.72	$3,200	51.28	.....	.....	$6,240	$6,273	.....	.....	.....	$33
3	Sept. 30, 1897	1,950	33.36	3,896	66.64	.....	.....	5,846	5,188	$658	11.26	3.29	.....
4	Jan. 1, 1898	7,380	52.57	6,658	47.43	.....	.....	14,038	12,625	1,413	10.07	1.71	.....
5	Dec. 31, 1897	2,760	44.27	3,474	55.73	.....	.....	6,234	5,546	688	11.04	2.40	.....
6	Dec. 31, 1897	2,380	13.52	15,036	85.39	$192	1.09	17,608	16,760	848	4.82	4.24	.....
7	Dec. 1, 1897	8,910	34.71	15,621	60.85	1,141	4.44	25,672	19,404	6,268	24.42	5.45	.....
8	March 31, 1897	1,800	25.30	5,315	74.70	.....	.....	7,115	5,222	1,893	26.61	3.65	.....
9	Dec. 31, 1897	1,596	15.96	8,404	84.04	.....	.....	10,000	10,824	.....	.....	.....	824
10	Oct. 31, 1897	1,932	26.00	5,500	74.00	.....	.....	7,432	5,827	1,605	21.60	4.46	.....
11	Dec. 31, 1897	20,600	65.19	10,755	34.03	245	.78	31,600	26,560	5,040	15.95	8.53	.....
12	April 1, 1897	8,780	27.41	15,736	49.13	7,512	23.46	32,028	27,260	4,768	14.89	3.15	.....
13	Dec. 31, 1896	10,827	29.36	23,229	62.98	2,825	7.66	36,881	32,122	4,759	12.90	3.01	.....
14	Dec. 31, 1897	24,575	56.93	17,872	41.40	720	1.67	43,167	40,960	2,207	5.11	.91	.....

TABLE X. ELECTRIC LIGHT, ETC., PLANT: PRI-
(MUNICIPAL PLANTS) OF

Plant Number.	Ownership.	Report for year ending.	Type of Lamp.	Arc Lighting.						
				Watts per Lamp.	Number of lamps in service.		Prices per kilowatt hour to private users.		Prices (when bought) or cost (when made) per kilowatt hour to municipality.	
					Private.	Municipal.	Maximum.	Minimum.	Maximum.	Minimum.
1	Private.	June 30, 1897.	C. V. O. arc.	500	.....	38	.....	.....	$0.0800	$0.0800
			C. V. incand.	.....	.....	.....	.....	.....	.....	.....
			C. V. incand.	.....	.....	.....	.....	.....	.....	.....
2	Private.	Oct. 12, 1897.	C. A. O. arc.	441	.....	101	.....	.....	.0461	.0461
3	Private.	Sept. 30, 1897.	C. A. O. arc.	306	.....	30	.....	.....	.1164	.1164
			C. V. incand.	.....	.....	.....	.....	.....	.....	.....
			C. V. incand.	.....	.....	.....	.....	.....	.....	.....
			C. V. incand.	.....	.....	.....	.....	.....	.....	.....
			C. V. incand.	.....	.....	.....	.....	.....	.....	.....
4	Private.	Jan. 1, 1898.	C. V. O. arc.	306	.....	76	.....	.....	.0840	.0840
			C. V. O. arc.	405	52	.....	$0.0384	$0.0384	.....	.....
			A. incand.	.....	.....	.....	.....	.....	.....	.....
5	Private.	Dec. 31, 1897.	C. A. O. arc.	340	2	28	.1021	.1021	.1021	.1021
			A. incand.	.....	.....	.....	.....	.....	.....	.....
			A. incand.	.....	.....	.....	.....	.....	.....	.....
			A. incand.	.....	.....	.....	.....	.....	.....	.....
			A. incand.	.....	.....	.....	.....	.....	.....	.....
			A. incand.	.....	.....	.....	.....	.....	.....	.....
			A. incand.	.....	.....	.....	.....	.....	.....	.....
6	Private.	Dec. 31, 1897.	A. incand.	.....	.....	.....	.....	.....	.....	.....
			A. incand.	.....	.....	.....	.....	.....	.....	.....
			A. incand.	.....	.....	.....	.....	.....	.....	.....
7	Private.	Dec. 1, 1897.	C. A. O. arc.	300	.....	86	.....	.....	.1667	.1667
			A. incand.	.....	.....	.....	.....	.....	.....	.....
			A. incand.	.....	.....	.....	.....	.....	.....	.....
			A. incand.	.....	.....	.....	.....	.....	.....	.....
			A. incand.	.....	.....	.....	.....	.....	.....	.....
			A. incand.	.....	.....	.....	.....	.....	.....	.....

CES (PRIVATE PLANTS), AND COST OF PRODUCTION.
LIGHT AND POWER SERVICE.

Candle power of lamps.	Number of lamps in service: Private.	Number of lamps in service: Municipal.	Prices per unit to private users. Unit.	Prices per unit to private users. Maximum.	Prices per unit to private users. Minimum.	Prices (when bought) or cost (when made) per unit to municipality. Unit.	Prices (when bought) or cost (when made) per unit to municipality. Maximum.	Prices (when bought) or cost (when made) per unit to municipality. Minimum.	Motor Service prices to users.	Plant Number.
INCANDESCENT LIGHTING.										
..	.....	.....	.....	.....	.....	.....	.....	.....		1
16	450	.....	k. w. hr.	$.2000	$.2000	.....	.....	.....		
16	550	.....	lamp per mo.	.8500	.8500	.....	.....	.....		
..	.....	.. ...	.....	.....	.....	.....	.....	.....		2
.	.....	.....	.....	.....	.....	.....	.....	.....		3
10	200	.....	lamp per mo.	.4500	.4500	.....	.....	.....		
16	50	.....	lamp per mo.	.4500	.4500	.....	.....	.....		
20	475	.....	lamp per mo.	.4500	.4500	.....	.....	.....		
32	25	.....	lamp per mo.	.4500	.4500	.....	.....	.....		
..	.....	.....	.....	.....	.....	.....	.....	.....		4
..	.....	.....	.....	.....	.....	.....	.....	.....		
16	500	.....	lamp per mo.	.6000	.6000	.....	.....	.....		
..	.....	.....	.....	.....	.....	.....	.....	.....		5
10	260	.....	k. w. hr.	.1800	.1800	.....	.....	.....		
10	94	7	lamp per mo.	.9000	.7500	lamp per yr.	3.0000	3.0000		
16	166	10	k. w. hr.	.1800	.1800	lamp per yr.	4.9000	4.9000		
20	102	17	lamp per mo.	1.0000	1.0000	lamp per yr.	6.2400	6.2400		
25	.....	39	.....	.. ....	.....	lamp per yr.	16.0000	16.0000		
32	5	.....	k. w. hr.	.1800	.1800	.....	.....	.....		
16	2,450	.....	lamp per mo.	.4500	.4500	.....	.....	.....		6
25	.....	140	.....	.....	.....	lamp per yr.	17.0000	17.0000		
32	156	.....	lamp per mo.	1.2867	1.0000	.....	.....	.....		
..	.....	.....	.....	.....	.....	... .	.....	.....		7
10	48	.....	k. w. hr.	.2500	.2500	.....	.....	.....		
16	4,330	.....	k. w. hr.	.2500	.2500	.....	.....	.....		
16	750	.....	lamp per mo.	1.0000	1.0000	.....	.....	.....		
32	20	.....	k. w. hr.	.2500	.2500	....	.....	.....		
32	30	.....	lamp per mo.	1.7500	1.7500	.....	.....	.....		

TABLE X. ELECTRIC LIGHT, ETC., PLANT : PRI-
(MUNICIPAL PLANTS) OF LIGHT

Plant Number.	Ownership.	Report for year ending	Type of Lamp.	Arc Lighting.						
				Watts per Lamp.	Number of lamps in service.		Price per kilowatt hour to private users.		Prices (when bought) or cost (when made) per kilowatt hour to municipality.	
					Private.	Municipal.	Maximum.	Minimum.	Maximum.	Minimum.
8	Private.	March 31, 1897.	A. incand.	.....	.....	.....	.....	.....	.....	.....
			A. incand.	.....	.....	.....	.....	.....	.....	.....
9	Private.	Dec. 31, 1897.	C. A. O. arc.	340	25	7	$.1697	$.1697	$.0962	$.0962
			A. incand.	.....	.....	.....	.....	.....	.....	.....
			A. incand.	.....	.....	.....	.....	.....	.....	.....
			A. incand.	.....	.....	.....	.....	.....	.....	.....
			A. incand.	.....	.....	.....	.....	.....	.....	.....
10	Private.	Oct. 31, 1897.	C. V. O. arc.	325	.....	23	.....	.....	0.1381	0.1381
			A. incand.	.....	.....	.....	.....	.....	.....	.....
11	Private.	Dec. 31, 1897.	C. V. O. arc.	550	30	.....	.1000	.1000	.....	.....
			C. A. O. arc.	325	70	.....	.1567	.1204	.....	.....
			C. A. O. arc.	450	.....	188	.....	.....	.0741	.0741
			C. V. incand.	.....	.....	.....	.....	.....	.....	.....
12	Private.	April 1, 1897.	C. A. O. arc.	340	*a* 112	138	.1508	.1384	.0817	.0817
			C. A. incand.	.....	.....	.....	.....	.....	.....	.....
			C. A. incand.	.....	.....	.....	.....	.....	.....	.....
			C. A. incand.	.....	.....	.....	.....	.....	.....	.....
			A. incand.	.....	.....	.....	.....	.....	.....	.....
			A. incand.	.....	.....	.....	.....	.....	.....	.....
			A. incand.	.....	.....	.....	.....	.....	.....	.....
13	Private.	Dec. 31, 1896.	C. A. O. arc.	405	46	169	.1908	.1610	.1058	.0556
			A. incand.	.....	.....	.....	.....	.....	.....	.....
			A. incand.	.....	.....	.....	.....	.....	.....	.....
			A. incand.	.....	.....	.....	.....	.....	.....	.....
			A. incand.	.....	.....	.....	.....	.....	.....	.....
			A. incand.	.....	.....	.....	.....	.....	.....	.....
			A. incand.	.....	.....	.....	.....	.....	.....	.....

CES (Private Plants), AND COST OF PRODUCTION.

AND POWER SERVICE — Continued.

Candle power of lamps.	Incandescent Lighting. Number of lamps in service. Private.	Municipal.	Prices per unit to private users. Unit.	Maximum.	Minimum.	Prices (when bought) or cost (when made) per unit to municipality. Unit.	Maximum.	Minimum.	Motor Service prices to users.	Plant Number.
16	2,600	.....	lamp per mo.	$ .7500	$ .1250	.....	.....	.....		8
24	.....	100	.....	.....	.....	lamp per yr.	$18.0000	$18.0000		
..	.....	.....	.....	.....	.....	.....	.....	.....		9
16	2,425	.....	k. w. hr.	.1250	.1250	.....	.....	.....		
20	50	.. ..	k. w. hr	.1250	.1250	.....	.....	.....		
25	.....	41	.....	.....	.....	lamp per yr.	21.0000	21.0000		
32	25	.....	k. w. hr.	.1250	.1250	....	.....	.....		
..	.....	.....	.....	.....	.....	.....	.....	.....		
16	810	.....	lamp per mo.	.7500	.1250	.....	.....	.....		
..	.....	.....	.....	.....	.....	.....	.....	.....		10
..	.....	.. ..	.....	.....	.....	.....	.....	.....		
..	.....	... ..	.....	.....	.....	.....	.....	.....		11
16	1,500	.....	k. w. hr.	.1250	.1250	.....	.....	.....	$0.1250 per. k. w. hr.	
..	.....	.....	.....	.....	.....	.....	.....	.....		12
25	.....	17	.....	.....	.....	lamp per yr.	19.0000	19.0000	$0.06 pr. H. P. hr. (*c*.)	
32	.....	7	... .	.....	.....	lamp per yr.	21.0000	21.0000	$2.00 pr. motor pr. mo.	
65	14	1	lamp per mo.	3.0000	3.0000	lamp per yr.	30.0000	30.0000	$30.00 pr. H.P. pr. yr.	
16	243	.....	k. w. hr.	*b* .1500	*b* .1500	.....	.....	.....		
20	1,129	.....	k. w. hr.	*b* .1500	*b* .1500	.....	.....	.....		
32	53	.....	k. w. hr.	*b* .1500	*b* .1500	.....	.....	.....		
..	.....	.....	....	.....	.....	.....	.....	.....		13
4	100	.....	k. w. hr.	*d* .1750	*d* .1750	....	.....	.....	$65.00 pr. H. P. pr. yr.	
6	10	.....	k. w. hr.	*d* .1750	*d* .1750	.....	.....	... .		
10	150	.....	k. w. hr.	*d* .1750	*d* .1750	.....	.....	.....		
16	3,750	.....	k. w. hr.	d .1750	*d* .1750	.....	.....	.....		
20	32	.....	k. w. hr.	*d* .1750	*d* .1750	.....	.....	.....		
2	50	.....	k. w. hr.	*d* .1750	*d* .1750	.....	.....	.....		

TABLE X. ELECTRIC LIGHT, Etc., PLANT: PRI-

(MUNICIPAL PLANTS) OF LIGHT

Plant Number.	Ownership.	Report for Year ending	Type of Lamp.	Arc Lighting.						
				Watts per Lamp.	Number of lamps in service.		Prices per kilowatt hour to private users.		Prices (when bought) or cost (when made) per kilowatt hour to municipality	
					Private.	Municipal.	Maximum.	Minimum.	Maximum.	Minimum.
14	Private.	Dec. 31, 1897.	C. A. O. arc.	460	30	170	$.0912	$.0912	$.0715	$.0715
			A. incand.	.....	.....	.....	.....	.....	.....	.....
			A. incand.	.....	.....	.....	.....	.....	.....	.....
			A. incand.	.....	.....	.....	.....	.....	.....	.....

a Including an unknown number of lamps used irregularly, prices not reported.
b Also special contract rates, prices not reported.

CES (Private Plants), AND COST OF PRODUCTION.

AND POWER SERVICE— Concluded.

Incandescent Lighting.										
Candle power of lamps.	Number of lamps in service.		Prices per unit to private users.			Prices (when bought) or cost (when made) per unit to municipality.			Motor Service prices to users.	Plant Number.
	Private.	Municipal.	Unit.	Maximum.	Minimum.	Unit.	Maximum.	Minimum.		
..	.....	.....	.....	.....	.....	....	.....	.....	$0.20 per. k. w. hr.	14
16	5,025	.....	k. w. hr.	$ .2000	$ .2000	.....	.....	.....		
25	.....	167	.....	.....	.....	lamp per yr.	$25.0000	$25.0000		
32	1,010	.....	k. w. hr.	.2000	.2000	....	.....	.....		

c Subject to discount of from 10 to 50 per cent.

d Subject to discount of from 5 to 20 per cent.

DESCRIPTIVE ANALYSIS OF THE ELECTRIC LIGHT AND POWER PLANTS.

Table I gives information concerning the plants, the distributing circuits, and the apparatus owned. Only two of the fourteen have changed ownership — No. 4, four years after it was established, and No. 14, three years after it was started. All of them, save one, use steam power to a greater or less extent. That one used water power entirely, while four others supplement their steam power with water power. The least horse power capacity of the engines of any establishment is one hundred, and the greatest is 1,200, while the minimum horse power of the boilers is one hundred and the maximum is eight hundred. The number of dynamos used in each establishment is from two to thirteen, and the kilowatt capacity varies from forty to seven hundred and twenty-four. The length of main wires reaches from three miles, in the smallest, to 132.36 miles in the largest plant; and the weight of copper therein is between 3,280 pounds in the former and 75,359 pounds in the latter concern. The length of feeder wires in the several instances is from one to twenty miles, with a weight of copper from 1,000 to 51,057 pounds. From two to fifty miles of streets are served from these wires. All of these lines are aerial, none being underground wires. The least number of transformers in use in any one system is twenty, and as many as one hundred and fifty are used in one instance. The voltage of the primary currents in the various cases has a strength of 1,000 in the weakest and 2,080 in the strongest. The total output capacity in watts measures from 15,000 to 252,900. The least number of arc lights connected to any one station is twenty-three and the greatest number is two hundred and eighty-eight, while the least number of incandescent lamps, where there are such, is five hundred, and the greatest is 6,202. Those companies which furnish power by stationary motors connected sell from eight to five hundred and sixty-six and one-sixth horse power each.

Table II discloses such data as could be secured concerning fuel conditions and water supply. It shows that the bituminous

coal consumed under the boilers of the electric stations costs the companies at prices varying from $1.88 to $4.46 per ton. The water power used is at an expense of from $4.86 to $8 per horse power.

Table III reveals the investment in each plant, the classifications being investment in land, in buildings, in steam or water power plant, in electric power plant, and in distributing circuits, lamps, and apparatus. Taking the average, the least investment is in the lands, and the greatest is in the distributing circuits, lamps, and apparatus, the amounts invested in the other divisions grading upward in the above order. One had land donated, two lease their lands and buildings, and the cost of the land for the remaining stations was between $250 and $28,500, inclusive; of the buildings, between $1,016 and $55,000, inclusive; of the steam or water power apparatus, between $4,285 and $85,500, inclusive; of the electric power appliances, between 1,700 and $47,000, inclusive; and of the distributing circuits, lamps, and apparatus, between $2,705 and $56,000, inclusive. The total investment in the several concerns is from $17,512 to $243,000.

Table IV produces the data reported in regard to the sources of the funds used in the investment in the municipal electric light plant which responded to the Bureau.

Table V shows the gross income of the several companies. Of the total gross income of each, the per cent. which comes from lighting ranges from 76.54 to 100. Over one-half of them receive their entire income from lighting. The money received for illuminating is, on the average, about equally divided between arc service and incandescent service. Quite a substantial earning is also secured, by a few of the establishments, from stationary motor service and from power to electric railways.

Table VI presents the cost of production. The general expenses, including salaries of officers, office supplies and expenses, insurance, legal expenses and damages, etc., amount from 10.82 per cent. to 36.44 per cent. of the total manufacturing cost in the generation of the electricity; wages amount from 14.36 per cent. to 37.09 per cent.; supplies from 13.35 per cent. to 32.77 per

cent.; maintenance, including actual disbursements for repairs and renewals, from .49 per cent. to 3.66 per cent. of the total investment, exclusive of land; estimated depreciation is placed from 2.65 per cent. to 7.32 per cent. of the total investment, exclusive of land; the total maintenance charges vary from 3.15 per cent. to 8.24 of the total investment, exclusive of land, and from 16.09 per cent. to 48.42 of the total cost of production. There are also given the taxes and the total cost of production with and without the taxes.

Table VII exhibits the distribution of the cost of production of the one municipal plant that reported. The cost of production, to the city, including estimated depreciation, is $4,431.

Table VIII deals with certain additional elements theoretically entering into the cost in the plant owned by a municipality. It figures that, with estimated taxes, with the interest on the total investment, and with the additional expense of the arc lighting, there is theoretically an increased cost per kilowatt per hour of $0.0096 over that shown in Table VII. There is no incandescent lighting in this plant.

Table IX furnishes information concerning the profit and loss of the private plants. It will be seen that two of the concerns show a net loss — No. 1, of $33, and No. 9, of $824 — but whether these two did actually suffer a loss may be judged by noting that No. 1 has charged off $1,046 in "estimated depreciation" (see Table VI); and by the same table one finds that No. 9 charged off, in the same manner, $3,966. The remaining plants reveal net profits from 4.82 per cent. to 26.61 per cent. of their gross incomes, and from .91 per cent. to 8.53 per cent. on their total investment; and this, too, after the large charging off in "estimated depreciation" found in Table VI.

Table X treats of the prices and cost of production of light and power service. This table compares the prices of the electric lights to private users and the prices of lights to municipalities, showing that the municipalities are furnished their lights at a lower figure than are private users. No. 5 furnishes incandescents to private users at the same rate per kilowatt per hour as to municipalities, namely at $0.1021. But No. 9 sells to munici-

palities nearly 50 per cent. cheaper than to private users, charging the former $0.0962 per kilowatt per hour, while the latter have to pay $0.1697. No. 12 serves arc lights to municipalities at the fixed rate of $0.0817 and to private users at rates varying from $0.1508 down to $0.0384 per kilowatt per hour. No. 13 vends arc lights to private users at prices varying from $0.1908 to $0.1610, but to municipalities at prices from $0.1058 down to $0.0556 per kilowatt per hour. No. 14 charges private users $0.0912 per kilowatt per hour and municipalities $0.0715. In incandescent lighting, similar conditions are found. Municipalities are buying their incandescent lights at a lesser cost than private users. It is not easy to draw comparisons from the table, as private users' prices are, for the most part, quoted by the month and the prices to municipalities are given per annum. But an examination of the quotations for incandescent lighting by Nos. 5, 6, 9, 12, and 14 bear out the conclusion that municipalities have the best of it. The number of arc lights attached to the various plants varies from twenty-three to two hundred and fifty, and the number of incandescents from none in one plant to 7,778 in the largest concern. The power of the arc lights in Connecticut is between three hundred and five hundred and fifty watts, inclusive, per lamp; the power of the incandescent lamps, between four and sixty-five candle power each, inclusive.

GAS WORKS.

The information relating to gas works is presented in the eight subsequent tables. These tabulated statistics closely resemble those given above in connection with the electric light and power plants. Table I treats of "Plant, Distributing Equipment, and Apparatus Owned;" Table II, "Fuel Conditions and Water Supply;" Table III, "Investment;" Table IV, "Gross Income;" Table V, "Cost of Production;" Table VI, "Result of Operation;" Table VII, "Profit and Loss," and Table VIII, "Prices and Cost of Production."

Here, too, as in the case of the electric tables, the data given in the tabulations are for a period of one year, unless the table itself otherwise states. The fiscal year, of each of the works, which most closely coincides with the year between January 1, 1897, and January 1, 1898, is the year from which these statistics are taken.

Of the nine gas companies which are herein treated, not one is under municipal control. That the business that the gas works do is profitable is not only shown by the statistics in the tables but by the fact that a large per cent. of the works do not change ownership, and the few that were sold did not often experience a new management. In the cases of most of these concerns the tables show that there is a net profit in the business, and "estimated depreciation" and "leakage" will account for any showing otherwise.

Several facts may be noticed as of especial interest. The average per cent. of labor, in the cost of producing gas, here

seems to be about eighteen. This is a less per cent. of the total cost, for the wage-earner, than goes into the production of electricity, but material and supplies are used, in the manufacture of gas, which represent labor. Several concerns secure quite an income, in addition to that from the sale of gas, from the sale and rent of gas apparatus, and from the sale of " by-products " and " residuals."

It will be seen that municipalities purchasing gas do not have such a reduced price, under private users, as is the case in purchasing electricity. The tables show no concern furnishing " dollar gas," although since January 1, 1898, some of them have commenced to sell at one dollar per thousand cubic feet. The statistics follow:

TABLE I. GAS WORKS. PLANT, DISTRIBUTING

PRIVATE

Plant Number.	Ownership.	Year constructed.	Present ownership dates from	Generating Plant, Coal Gas.				Generating Plant, Water Gas.			
				Style of setting.	Boilers.		Daily capacity, cubic feet.	Generators.	Boilers.		Daily capacity, cubic feet.
					Number.	Total rated capacity, H. P.			Number.	Total rated capacity, H. P.	
1	Private.	1888	1888	.....	.....	.....	.....	2	1	60	75,000
2	Private.	1878	1889	.....	.....	.....	.....	1	2	375	60,000
3	Private.	1882	1882	.....	.....	.....	.....	2	2	32	80,000
4	Private.	1860	1890	.....	.....	.....	.....	1	1	18	125,000
5	Private.	1856	1856	Plain.	2	30	90,000	.....	.....	.....	.....
6	Private.	1854	1854	Plain.	2	50	150,000	.....	.....	.....	.....
7	Private.	1854	1893	.....	.....	.....	.....	1	2	40	300,000
8	Private.	1857	1857	*b* Plain.	1	25	115,000	.....	.....	.....	.....
9	Private.	1860	1860	*b* Plain.	2	80	300,000	.....	.....	.....	.....

b Also regenerative.

EQUIPMENT AND APPARATUS OWNED.

PLANTS.

Purifying Plant.			Gas Holders.		Street Mains.				Meters.		Plant Number.
Condensers.	Scrubbers.	Purifying boxes.	Number.	Total capacity, cubic feet.	Size (diameter inches). Largest.	Smallest.	Average.	Total length in miles.	Prepayment.	Other.	
a 1	*a* 1	4	1	13,000	6.00	2.00	3.67	4.00	.....	75	1
1	1	2	2	50,000	10.00	2.00	4.04	3.96	.....	310	2
1	.....	1	2	29,000	6.00	1.50	3.86	14.28	.....	183	3
a 1	*a* 1	4	2	165,000	6.00	3.00	3.27	19.00	.....	300	4
1	1	4	4	131,000	12.00	1.00	4.13	20.41	.....	775	5
1	1	4	2	140,000	12.00	2.00	5 52	20.26	.....	850	6
.....	1	4	2	244,000	16 00	2 00	5 89	21 91	.....	1,200	7
1	1	4	2	310,000	12.00	3.00	5.41	14.94	12	900	8
1	1	4	2	234,000	12.00	1.50	5 64	18.54	.....	1,080	9

a Friction condenser and scrubber combined.

TABLE II. GAS WORKS. FUEL

PRIVATE

Plant number.	Ownership.	Fuel.	
		Coal.	
		Kind.	Cost per 2,000 pounds.
1	Private	Anthracite	$4.46
2	Private	Bituminous	3.57
3	Private	Bituminous	3.48
4	Private	Anthracite	3.30
5	Private		
6	Private		
7	Private	Bituminous	3.11
8	Private		
	Private		

CONDITIONS AND WATER SUPPLY.

PLANTS.

Fuel.			Water supply, cost per year.	Plant number.
Other.				
Kind.	Unit of price.	Cost per unit.		
.....	.....	.....	$121	1
.....	.....	.....	.....	2
.....	.....	.....	347	3
.....	.....	.....	25	4
a Coke.....	*a*	*a*	175	5
a Coke	*a*	*a*	.....	6
.....	.....	.....	45	7
a Coke.....	*a*	*a*	5	8
a Coke.....	*a*	*a*	35	9

a By-product of coal gas, used as fuel.

TABLE III. GAS WORKS.

PRIVATE

Plant number.	Ownership.	Land.		Buildings.		Manufacturing equipment.		Holders.	
		Cost.	Per cent. of total investment.	Cost.	Per cent. of total investment.	Cost.	Per cent. of total investment.	Cost.	Per cent. of total investment
1	Private.	$175	0.66	$1,500	5.69	$4,300	16.30	$1,800	6.83
2	Private.	1,000	3.86	3,500	13.51	4,950	19.11	6,500	25.10
3	Private.	1,000	1.47	3,061	4.51	40,958	60.40	4,082	6.02
4	Private.	1,000	1.67	2,000	3.33	13,000	21.67	8,000	13.33
5	Private.	6,000	4.11	37,407	25.66	14,112	9.68	28,014	19.21
6	Private.	2,000	1.57	7,000	5.49	15,500	12.16	21,000	16.47
7	Private.	10,000	3.53	40,000	14.12	57,000	20.13	72,000	25.42
8	Private	12,000	6.38	18,000	9.58	40,250	21.41	75,000	39.89
9	Private.	15,000	8.12	40,816	22.10	21,505	11.64	26,882	14.56

INVESTMENT.

PLANTS.

Mains.		Meters.		Teams, tools, and other accessories.		Total investment.	Plant number.
Cost.	Per cent. of total investment.	Cost.	Per cent. of total investment.	Cost.	Per cent. of total investment.		
$17,350	65.78	$1,250	4.74	.....	.....	$26,375	1
8,320	32.12	1,380	5.33	$250	0.97	25,900	2
16,469	24.29	2,054	3.03	191	.28	67,815	3
35,000	58.34	710	1.18	290	.48	60,000	4
52,437	35.96	6,235	4.28	1,599	1.10	145,804	5
76,400	59.92	5,100	4.00	500	.39	127,500	6
95,000	33.55	7,200	2.54	2,000	.71	283,200	7
33,750	17.95	7,000	3.72	2,000	1.07	188,000	8
67,742	36.68	10,753	5.82	2,000	1.08	184,698	9

TABLE IV. GAS WORKS.

PRIVATE

Plant number.	Ownership.	From Sale of Gas.							
		For Lighting.		For Cooking and Heating.		For Power.		Total.	
		Amount.	Per cent. of total gross income.	Amount.	Per cent. of total gross income.	Amount.	Per cent. of total gross income.	Amount.	Per cent. of total gross income.
1	Private.	$4,000	100.00	.....	.....	.....	.....	$4,000	100.00
2	Private.	5,383	76.18	$1,151	16.29	$252	3.57	6,786	96.04
3	Private.	16,860	93.41	1,140	6.32	.....	.....	18,000	99.73
4	Private.	12,500	94.80	580	4.40	.....	.....	13,080	99.20
5	Private.	(a)	.....	(a)	.....	(a)	.....	28,127	90.27
6	Private.	29,724	79.08	3,330	8.86	.....	.....	33,054	87.94
7	Private.	27,139	76.61	6,785	19.15	1,500	4.24	35,424	100.00
8	Private.	22,788	60.28	3,000	7.94	.....	.....	25,788	68.22
9	Private.	48,650	79.98	2,475	4.07	300	.49	51,425	84.54

a Not reported.

GROSS INCOME.

PLANTS.

From Rents and Sales of Appliances.		From Sales of By-Products and Residuals.		Total gross income.	Plant number.
Amount.	Per cent. of total gross income.	Amount.	Per cent. of total gross income.		
.....	.....	.....	.....	$4,000	1
$280	3.96	.....	.....	7,066	2
49	.27	.....	.....	18,049	3
105	.80	.....	.....	13,185	4
.....	.....	$8,033	9.73	31,160	5
705	1.88	3,826	10.18	37,585	6
.....	.....	.....	.....	35,424	7
2,447	6.47	9,570	25.31	37,805	8
1,500	2.47	7,900	12.99	60,825	9

TABLE V.[1] GAS WORKS:

PRIVATE

Plant number.	Ownership.	Report for the year ending	General Expenses.								Wages.	
			Salaries of officers, superintendents, clerks, etc.	Office supplies and expenses.	Insurance.	Legal expenses and damages.	Licenses and royalties.	Other.	Total.	Per cent. of total cost of production.	Total.	Per cent. of total cost of production.
1	Private.	Dec. 31, 1897	$100	$23	$25	.....	.....	..	$148	3.43	$674	15.60
2	Private.	May 1, 1898	1,000	110	50	$25	.....	.....	1,185	18.96	1,400	22.40
3	Private.	Dec. 31, 1897	1,950	105	100	500	.....	$415	3,070	22.62	1,924	14.17
4	Private.	Jan. 1, 1898	760	197	60	50	.....	.....	1,067	9.89	1,590	14.74
5	Private.	July 1, 1897	2,400	310	32	.....	.....	.....	2,742	11.88	4,502	19.50
6	Private.	Dec. 31, 1897	3,220	943	114	50	.....	25	4,352	21.26	3,592	17.55
7	Private.	Dec. 31, 1897	1,400	680	500	310	.....	.....	2,890	7.56	6,120	16.01
8	Private.	Dec. 31, 1897	4,000	475	2,500	.....	.....	25	7,000	14.17	7,095	14.36
9	Private.	Dec. 31, 1897	3,950	1,675	57	25	.....	62	5,769	11.89	8,715	17.96

COST OF PRODUCTION.

PLANTS (First Part).

Material and Supplies.					General distributing expenses.		Maintenance.							
							Actual Disbursements for Repairs and Renewals.							
							On works.		On mains.					
Fuel.	Materials used in manufacture.	Other supplies.	Total.	Per cent. of total cost of production.	Total.	Per cent. of total cost of production.	Total.	Per cent. of cost.	Total.	Per cent. of cost.	Others.	Total.	Per cent. of total investment exclusive of land.	Plant number.
$800	$890	$3	$1,693	39.20	.....	.....	.....	.....	$30	0.17	$15	$45	0.17	1
60	1,804	28	1,892	30.27	$294	4.70	$225	1.51	115	1.38	.....	340	1.37	2
494	5,008	35	5,537	40.79	789	5.81	.....	.....	100	.61	.....	100	.15	3
92	2,825	748	3,665	33.98	105	.97	.....	.....	225	.64	125	350	.59	4
a	9,400	175	9,575	41.47	.....	.....	.....	.....	500	.95	500	1,000	.71	5
a	7,827	35	7,862	38.40	1,048	5.12	1,492	3.43	177	.23	417	2,086	1.66	6
1,253	8,683	280	10,216	26 72	715	1.87	310	.18	860	.91	.....	1,170	.43	7
a	12,656	3,255	15,911	32.20	5,850	11.84	1,500	1.13	300	.89	475	2,275	1.29	8
a	10,782	190	10,972	22.61	3,035	6.26	2,750	3.08	6,500	9.60	1,222	10,472	6.17	9

a. Nothing; coke, by-product of coal gas used as fuel.

TABLE V.[2] GAS WORKS:

PRIVATE

Plant number.	Ownership.	Maintenance — Concluded.										
		Estimated Depreciation.								Total.		
		On building.		On manufacturing equipment.		On distribution system, meters, and apparatus.		Total.				
		Total.	Per cent. of cost.	Total.	Per cent. of cost.	Total.	Per cent. of cost.	Amount.	Per cent. of total investment exclusive of land.	Amount.	Per cent. of total investment exclusive of land.	Per cent. of total cost of production.
1	Private.	$30	2.00	$301	7.00	$1,428	7.00	$1,759	6.71	$1,804	6.88	41.77
2	Private.	70	2.00	247	4.99	823	5.00	1,140	4 57	1,480	5.94	23.67
3	Private.	61	1.99	1,638	4.00	456	2.00	2,155	3.23	2,255	3.38	16.61
4	Private.	40	2.00	910	7.00	3,060	6.95	4,010	6.80	4,360	7.39	40.42
5	Private.	748	2.00	988	7.00	3,532	4.00	5,268	3.77	6,268	4.48	27.15
6	Private.	140	2.00	390	2.52	1,002	.97	1,532	1.22	3,618	2.88	17.67
7	Private.	800	2.00	3,990	7.00	12,334	7.00	17,124	6.27	18,294	6.70	47.84
8	Private.	360	2.00	2,817	7.00	8,103	6.88	11,280	6.41	13,555	7.70	27.43
9	Private.	816	2.00	1,505	7.00	7,237	6.74	9,558	5.63	20,030	11.80	41.28

COST OF PRODUCTION.

PLANTS (Second Part).

Total cost of production.		Taxes.	Total cost of production and taxes.		Plant number.
Including estimated depreciation.	Excluding estimated depreciation.		Including estimated depreciation.	Excluding estimated depreciation.	
$4,319	$2,560	$126	$4,445	$2,686	1
6,251	5,111	367	6,618	5,478	2
13,575	11,420	202	13,777	11,622	3
10,787	6,777	529	11,316	7,306	4
23,087	17,819	640	23,727	18,459	5
20,472	18,940	1,225	21,697	20,165	6
38,235	21,111	1,450	39,685	22,561	7
49,411	38,131	1,500	50,911	39,631	8
48,521	38,963	2,951	51,472	41,914	9

TABLE VI. GAS WORKS.

PRIVATE

Plant number.	Ownership.	Report for the year ending	Candle power of gas at works.	Quantity of Gas to be Accounted For.		
				On hand at beginning of year, cubic feet.	Made during year, cubic feet.	Total, cubic feet.
1	Private.	Dec. 31, 1897	22	5,000	2,100,000	2,105,000
2	Private.	May 1, 1898	24	12,000	3,279,300	3,291,300
3	Private.	Dec. 31, 1897	35	11,000	5,091,210	5,102,210
4	Private.	Jan. 1, 1898	22	12,000	6,566,000	6,578,000
5	Private.	July 1, 1897	21	*a*	19,795,000	*b* 19,795,000
6	Private.	Dec. 31, 1897	18	100,000	22,012,185	22,112,185
7	Private.	Dec. 31, 1897	22	155,540	24,000,000	24,155,540
8	Private.	Dec. 31, 1897	18	223,000	26,153,000	26,376,000
9	Private.	Dec. 31, 1897	17½	151,000	36,023,000	36,174,000

a Not reported.

b Not including quantity on hand at beginning of year.

RESULT OF OPERATION.

PLANTS.

Quantity of Gas Accounted For.								
Lost by Leakage.		Used at Works and Offices.		Sold		On Hand at End of Year.		
Cubic feet.	Per cent. of total.	Cubic feet.	Per cent. of total.	Cubic feet.	Per cent. of total.	Cubic feet.	Per cent. of total.	Plant number.
5,000	0.24	95,000	4.51	2,000,000	95.01	5,000	0.24	1
15,000	0.46	9,000	.27	3,254,300	98.88	13,000	.39	2
55,950	1.10	80,480	1.58	4,954,260	97.10	11,520	.22	3
5,000	0.08	25,000	.38	6,540,000	99.42	8,000	.12	4
3,693,400	*c*	*d*	*d*	*e*16,101,600	*c*	*a*	*a*	5
2,605,000	11.78	520,100	2.35	18,886,085	85.41	101,000	.46	6
2,900,000	12.01	600,000	2.48	20,500,000	84.87	155,540	.64	7
10,280,522	38.98	1,500,000	5.69	14,326,478	54.31	269,000	1.02	8
3,562,000	9.85	370,000	1.02	32,144,000	88.86	98,000	.27	9

c Not obtainable for reasons stated in note *b*.
d Included in quantity of gas sold.
e Including gas used at works and office.

TABLE VII. GAS WORKS:

PRIVATE

Plant number.	Report for year ending	Gross Income.						
		From public service.		From commercial service.		From all other sources.		Total.
		Amount.	Per cent. of total gross income.	Amount.	Per cent. of total gross income.	Amount.	Per cent. of total gross income.	
1	Dec. 31, 1897	.....	.....	$4,000	100.00	.....	.....	$4,000
2	May 1, 1898	.....	.....	6.786	96.04	$280	3.66	7,066
3	Dec. 31, 1897	$2,400	13.30	15,600	86.43	49	.27	18,049
4	Jan. 1, 1898	500	3.79	12,580	95.41	105	.80	13,185
5	July 1, 1897	.....	.....	28,127	90.27	3,033	9.73	31.160
6	Dec. 31, 1897	.....	.....	33,054	87.94	4,531	12.06	37.585
7	Dec. 31, 1897	.....	.....	35,424	100.00	.....	.....	35.424
8	Dec. 31, 1817	.....	.....	25,788	68.21	12,017	31.79	37,805
9	Dec. 31, 1897	900	1.48	50,525	83.07	9,400	15.45	60 825

PROFIT AND LOSS.

PLANTS.

Total cost of production, including depreciation and taxes.	Net Profit.			Net loss.	Plant number.
	Amount.	Per cent. of gross income.	Per cent. on total investment.		
$4,445	.....	.....	.....	$445	1
6,618	$448	6.34	1.73	.....	2
13,777	4,272	23.67	6.30	.....	3
11,316	1,869	14.18	3.12	.....	4
23,727	7,433	23.85	5.10	.....	5
21,697	15,888	42.27	12.46	.....	6
39,685	.....	.....	.....	4,261	7
50,911	.....	.....	.....	13,106	8
51,472	9,353	15.37	5.06	.....	9

TABLE VIII. GAS WORKS: PRICES AND COST

PRIVATE

Plant number.	Ownership.	Report for year ending	LIGHTING.						
			Gas Consumed by Private Users.						
			Ordinary Meter Service.		Prepayment Meter Service.				
			Quantity used during year, cubic feet.	Price per 1,000 cubic feet.	Meters in service.	Quantity used during year, cubic feet.	Unit of price.	Price per 1,000 cubic feet.	Total quantity cubic feet.
1	Private.	Dec. 31, 1897.	2,000,000	$2.00	.....	.....	.....	.....	2,000,000
2	Private.	May 1, 1898.	2,319,000	*a* 2.50	.....	.....	.....	.....	2,319,000
3	Private.	Dec 31, 1897.	3,979,853	*b*	.....	.....	.....	.....	3,979,843
4	Private.	Jan. 1, 1898.	6,000,000	2.00	.....	.....	.....	.....	6,000,000
5	Private.	July 1, 1897.	*d* 16,101,600	*e* 2.00	.....	.....	.....	.....	*d* 16,101,600
6	Private.	Dec. 31, 1897.	16,243,000	*g* 1.90	.....	.....	.....	.....	16,243,000
7	Private.	Dec. 31, 1897.	14,080,000	*i* 2.00	.....	.....	.....	.....	14,080,000
8	Private.	Dec. 31, 1897.	12,653,811	*j* 2.00	12	6,000	$0.25	$1.80	12,659,811
9	Private.	Dec. 31, 1897.	29,844,000	*k* 1.65	.....	.....	.....	.....	29,844,000

a Subject to discount of 10 per cent. if paid within 10 days from date of bill.

b Water gas, $0.005 per foot, with discounts as follows: On bills of $3 to $10 per month, 5 per cent.; $10 to $25 per month, 10 per cent.; $25 to $300 per month, 15 per cent.; $300 and over per month, 20 per cent.

c Water gas $0.005 per foot.

d Including quantity of gas used for cooking and heating and for power.

e For less than 50,000 feet per year. For 50,000 to 100,000 feet per year, $1.95; 100,000 to 250,000 fee per year, $1.90; 250,000 to 300,000 feet per year, $1.85; 300,000 feet and over per year, $1.70; subject to further discount of 10 per cent. if paid within 10 days of date of bill.

OF PRODUCTION OF LIGHT, ETC., SERVICE.

PLANTS.

LIGHTING.							COOKING AND HEATING.				POWER.				
GAS CONSUMED BY MUNICIPALITY.							Appliances in Service.		Quantity of gas consumed during year, cubic feet.	Price per 1,000 cubic feet.	Gas Engines.		Quantity of gas consumed during year, cubic feet.	Price per 1,000 cubic feet.	Plant number.
Ordinary Meter Service.		Contract Service.													
		Other Lamps.													
Quantity used during year, cubic feet.	Price (when bought) or cost (when made) per 1,000 cubic feet.	Number in service.	Capacity cubic feet per hour	Total hours of service during year.	Price (when bought) or cost (when made) per lamp per year.	Total quantity, cubic feet.	Stoves.	Other.			Number in service.	Total capacity, H. P.			
.....	.....	....	..	.....	.....	.....	.....	.....	.....	.....	....	...	.....	.....	1
.....	.....	....	..	.....	.....	.....	80	15	767,600	$1.50	3	14	167,700	$1.50	2
99,000	*c*	102	2	2,780	$20.00	660,560	130	100	313,847	*b*	....	....	.....	.....	3
250,000	$2.00	....	..	.....	.....	250,000	35	20	290,000	2.00	....	....	.....	.....	4
.....	.....	....	..	.....	.....	.....	100	100	*f*	*a* 1.50	3	21	*f*	*a* 1.50	5
.....	.....	....	..	.....	.....	.....	350	20	2,643,085	*h* 1.40	....	....	.....	.....	6
.....	.....	....	..	.....	.....	.....	300	480	5,300,000	*i* 1.40	3	30	1,120,000	*i* 1.40	7
.....	.....	....	..	.....	.....	.....	250	100	1,666,667	*j* 2.00	....	....	.....	.....	8
600,000	1.50	....	..	.....	.....	600,000	275	150	1,500,000	*k* 1.65	4	26	200,000	1.50	9

f Included in quantity of gas consumed by private users.

g Subject to discounts as follows, if paid on or before 10th of month: On bills less than $10 per month, 5 per cent.; $10 to $20 per month, 10 per cent.; $20 and over per month, 20 per cent.

h Subject to discount of 10 per cent. if paid on or before 10th of month.

i Subject to discount of 12½ per cent. if paid within 10 days.

j Subject to discount of 10 per cent. if paid on or before 20th of month.

k For less than 100,000 feet per quarter year. For 100,000 feet or over per quarter year, $1.50

DESCRIPTIVE ANALYSIS OF THE GAS WORKS TABLES.

Table I informs concerning the plant, distributing equipment, and apparatus owned. Out of the nine establishments reporting, all are under private ownership. Six plants have not changed ownership since their establishment, and three have changed. Four generate coal gas and five, water gas. The daily producing capacity ranges from 60,000 to 300,000 cubic feet. They have from one to four gas holders each, with a total capacity of from 13,000 to 310,000 cubic feet in each establishment. The diameters of the street mains used are from one inch to sixteen inches, and the length of the various street mains is from 3.96 miles to 21.91 miles each. The number of meters of each concern ranges from seventy-five to 1,200.

Table II tells of the fuel conditions and water supply. For fuel, two employ anthracite coal, three consume bituminous coal, and four use coke. The anthracite costs, per ton, from $3.30 to $4.46, and the bituminous from $3.11 to $3.57. The water supply for these works costs from $35 to $450 each per year.

Table III treats of the investment in the several concerns. The total investment of each varies from $25,900 to $283,200. Of this total, from .66 per cent. to 8.12 per cent. is for land; from 3.33 per cent. to 25.66 per cent. is for buildings; from 9.68 per cent. to 60.40 per cent. is for the manufacturing equipment; from 6.02 per cent. to 39.89 per cent. is for holders; from 17.95 per cent. to 65.78 per cent. is for mains; from 1.18 per cent. to 5.82 per cent. is for meters, and from 28 per cent. to 1.10 per cent. is for teams, tools, and other accessories.

Table IV gives the sources of the gross income. It appears that the gas is sold for lighting, for cooking, for heating, and for power. The total income from the sale of gas ranges from $4,000 to $51,425 per plant per year, this being from 68.22 per cent. to 100 per cent. of the total gross income. The income from rents and sales of appliances, with companies so dealing, is from $49 to $2,447 per plant per annum, being from .27 per cent. to 6.47 per cent. of the total gross income in those instances. From the

sale of "by-products" and residuals are received sums varying between $3,033 and $9,570, inclusive, per year, this being from 9.73 per cent. to 25.31 per cent. of the total gross income. The total gross income of these plants ranges from $4,000 to $60,825 per plant each year.

Table V figures the cost of production. The general expenses range from $148 per establishment per year to $5,769, being from 3.43 per cent. to 22.62 per cent. of the total cost of production. In wages there are paid from $674 to $8,715 per year per plant, this being from 14.17 per cent. to 22.40 per cent. of the total cost of production. The materials and supplies make an expense of from $1,693 to $10,972 per annum in each establishment, this being from 26.72 per cent. to 41.47 per cent. of the total cost of production. The general distributing expenses vary from $105 to $5,850 each year in each instance, or from .97 per cent. to 11.84 per cent. of the total cost of production. The cost of maintaining each plant for a year is between $45 and $10,472, inclusive, that is from .15 per cent. to 6.17 per cent. of the total investment exclusive of land. The estimated depreciation is placed from $1,140 to $17,124, this being from 1.22 per cent. to 6.80 per cent. of the total investment. The total annual cost of production of each establishment, with taxes, and including estimated depreciation, is from $4,445 to $51,472, and excluding estimated depreciation is from $2,682 to $41,914.

Table VI furnishes the result of operation. Here are given statistics, to all practical purposes, for the year 1897, one plant, No. 2, being for the fiscal year ending May 1, 1898. The table shows that the amount of gas made during the year reported, in each manufactory, was from 2,100,000 cubic feet to 36,023,000 cubic feet. There was lost by leakage from 5,000 to 10,280,522 cubic feet per plant that year, or from .24 per cent. to 38.98 per cent. of the total amount made. There was sold during the year from 2,000,000 cubic feet to 32,144,000 by each company, or from 54.31 per cent. to 99.42 per cent. of the total manufactured product. The amount of leakage from plant No. 8 was unexplained, but must have resulted from unusual causes.

Table VII shows the profit and loss. This set of statistics reveals that six of the nine plants earned profits, during the year, of sums varying from $448 to $15,888 each, in spite of the fact that a large amount was charged off under " estimated depreciation " of the plants (see Table V). No. 1 shows a loss of $445, but it will be seen that in Table V $1,759 were charged off in " estimated depreciation " of its property. No. 7 shows a loss of $4,261, but Table V reveals that $17,124 were deducted in " estimated depreciation " of its works. No. 8 shows a loss of $13,106, but Table V informs the reader that $11,280 was charged off in " estimated depreciation," and Table VI shows that this same plant lost by leakage 10,280,522 cubic feet of gas during the year, a most unusual loss.

Table VIII presents the prices charged for gas. The gas consumed by private users, for lighting, was charged for at rates from $1.65 to $5 per thousand cubic feet, with discounts. The gas consumed by municipalities for lighting was from $1.50 to $5 per thousand cubic feet, and in No. 3 at $20 per lamp per year. No Welsbach type lamps were reported in use for municipal lighting. For cooking and heating, gas was furnished between $1.40 and $2, inclusive, per thousand cubic feet, with discounts. For power, gas was sold at a price ranging from $1.40 to $1.50 per thousand cubic feet, with discounts.

WATER WORKS.

The eleven tables hereinafter published concerning certain water works of this State are, in the main, like those heretofore presented in connection with the electric plants and gas establishments. The facts presented by each table are as follows: Table I, "Fuel Conditions;" Table II, "Plant, Distributing Equipment, and Apparatus Owned;" Table III, "Investment;" Table IV, "Sources of Funds used in the Investment of Municipal Plants;" Table V, "Gross Income;" Table VI, "Cost of Production;" Table VII, "Results of Operation;" Table VIII, "Distribution of Cost of Production in Municipal Plants;" Table IX, "Certain Additional Elements Theoretically Entering into Municipally Owned Plants;" Table X, "Profit and Loss of Private Plants;" and Table XI, "Prices of Private Plants and Cost of Production of Municipal Plants."

The following observations may be of interest before a perusal of the tables; the year presented is the fiscal year of each establishment most closely coinciding with the calendar year, 1897. Out of the thirty-four concerns, only three have ever changed ownership. Twelve are municipal plants and twenty-two are private. As many as 96.68 miles of mains are in use in a single establishment. The total amount of money invested in each plant ranges from $2,500, in the smallest, to $2,798,061, or practically three million dollars, in the largest. The bonds that have been issued to float the indebtedness of municipal plants never have been sold below par, and as much as $107.50 has been paid per $100 par. The interest paid upon these bonds has been from 3.50 to 7 per

cent. Practically all the income of these concerns is from the sale of water; as, from the nature of the case, little else can be introduced to increase the revenue.

The amount of labor that goes into production, in the case of water works, is very small after the plant is constructed. During the building of the system, however, the laborer has a lion's share of the investment in the construction of reservoirs, stand-pipes, tanks, pumping stations, conduits, water mains, etc. These tables show that the laborer's per cent. of the total cost of production, in the year given, is from .37 to 62.24; but to state an average, taking in the whole history of a plant, would be difficult; true it is, however, that mains and other constructions are not permanent and have to be rebuilt from time to time, so that the laborer has his share.

That the water production is profitable is shown by the fact that, of the twelve municipal plants, eleven municipalities secure their water without cost and make a handsome profit out of the private users, although large sums have been charged off in "estimated depreciation"; the twelfth municipal establishment claims to have lost (that is, paid for its own water) $6,383, but it appears that, in Table VI, $10,558 were taken off in "estimated depreciation," so that here, too, probably, the municipality really had its water without cost and realized some profit. The twenty-two private plants, also, with one exception, show profits. The concern that seems an exception is No. 22, and while it figures a net loss of $8,254 upon the year in question, in Table VI one may find that it charged off $7,252 by "estimated depreciation," and spent, this same year, an unusual amount ($14,762) in reconstructing its plant.

From the above facts, and from Table XI, it is fair to conclude that, in the municipally-owned plants, those towns, cities and boroughs make a profit from the private users and secure the water for public uses without cost, while in privately-owned plants, on the whole, municipalities have to pay as much for their water as private users.

The statistical tables follow:

TABLE I. WATER WORKS: FUEL CONDITIONS—PRIVATE AND MUNICIPAL PLANTS.

Plant number.	Ownership.	FUEL.	
		Character of coal used.	Cost per 2,000 pounds.
1	Private	.....	.....
2	Private	.....	.....
3	Private	(*a*)	(*a*)
4	Private	.....	.....
5	Private	.....	.....
6	Private	.....	.....
7	Private	.....	.....
8	Private	.....	.....
9	Private	.....	.....
10	Private	.....	.....
11	Private	.....	.....
12	Municipal	.....	.....
13	Private	.....	.....
14	Private	.....	.....
15	Private	.....	.....
16	Private	.....	.....
17	Private	.....	.....
18	Municipal	Bituminous *b*	$3.75
19	Private	Bituminous	2.46
20	Private	Bituminous *c*	4.49
21	Private	.....	.....
22	Private	.....	.....
23	Municipal	.....	.....
24	Municipal	.....	.....
25	Municipal	.....	.....
26	Municipal	.....	.....
27	Private	.....	.....
28	Municipal	.....	.....
29	Municipal	.....	.....
30	Municipal	.....	.....
31	Municipal	Bituminous	4.69
32	Municipal	.....	.....
33	Municipal	.....	.....
34	Private	Bituminous	3.25

a Wood used; price not reported. *b* Wood and oil also used. *c* Wood also used.

TABLE II. WATER WORKS: PLANT, DISTRIBUTING AND MUNICIPAL

Plant number.	Ownership.	Year Constructed.	Present ownership. dates from	SOURCE OF SUPPLY.					KIND OF DIST'N.	
				Character.	Distance from pumping works or mains, feet.	Conduits from source of supply to pumping works or mains.			GRAVITY.	
						Character.	Dimensions.		Head of Water, feet.	Total storage capacity, gallons.
							Length, feet.	Diam., feet.		
1	Private	1877	1877	Creeks	2,640	Iron pipe	2,640	[a]...	60	800,000
2	Private	1890	1890	Lakes	[a].....	Iron pipe	[a].....	[b]...	250	3,500,000
3	Private	1892	1892	Springs	.....	.....	.....	....	....	.....
4	Private	1893	1893	Creek	13,200	Iron pipe	22,000	[c]...	160	2,500,000
5	Private	1882	1882	Creek	.....	.....	.....	....	200	60,000,000
6	Private	1880	1880	Lakes [f]	[a].....	.....	.....	....	275	80,000,000
7	Private	1879	1879	Creeks [g]	7,920	Iron pipe	7,920	6	200	750,000
8	Private	1889	1889	Creeks [g]	15,307	Iron pipe	15,307	6	200	36,000,000
9	Private	1870	1870	Springs	5,280	Iron pipe	5,280	8	150	8,000,000
10	Private	1884	1884	Creeks [f]	[a].....	Iron pipe	[a].....	[a]...	235	300,000,000
11	Private	1886	1886	Creek	[a].....	Iron pipe	[a].....	[a]...	285	25,500,000
12	Municipal	1878	1878	Springs	5,250	Iron pipe	5,250	12	170	95,000,000
13	Private	1884	1884	Creeks [g]	[a].....	Iron pipe	2,640	12	60	150,000,000
14	Private	1874	1874	Springs [g]	[a].....	Iron pipe	[a].....	[a]...	300	10,000,000
15	Private	1872	1872	Creeks [g]	2,640	Iron pipe	[h].....	[h]...	150	15,000,000
16	Private	1847	1893	Lake	2,640	.....	.....	....	120	1,058,508,000
17	Private	1889	1889	Creek	.....	.....	.....	....	297	60,000,000
18	Municipal	1884	1884	River	25	.....	.....	....	....	.....
19	Private	1888	1888	Creek	[a].....	.....	.....	....	....	.....
20	Private	1885	1885	Springs	3,960	Iron pipe	3,960	[a]...	....	.....
21	Private	1860	1860	Creek	2,640	Iron pipe	2,640	12	240	90,000,000
22	Private	1888	1888	Creeks	.....	.....	.....	....	200	120,000,000
23	Municipal	1862	1862	River [g]	8,257	Iron pipe	8,257	[i]...	271	398,574,000
24	Municipal	1882	1882	Lake	[a].....	Iron pipe	[a].....	[a]...	240	600,000,000
25	Municipal	1875	1875	Creeks	26,168	Iron pipe	[k].....	[k]...	266	675,000,000
26	Municipal	1866	1866	Creeks [g]	[l].....	Iron pipe	[m].....	[m]...	[n]...	495,000,000
27	Private	1878	1878	Springs [o]	[a].....	.....	.....	....	175	18,000,000
28	Municipal	1872	1872	Lakes	29,040	[p].....	60,280	[q]...	[r]...	950,269,788
29	Municipal	1857	1857	Creeks	13,500	Iron pipe	27,100	[s]...	175	1,500,000,000
30	Municipal	1868	1868	Creeks	9,785	Iron pipe	26,930	[aa]...	243	390,000,000
31	Municipal	1869	1869	Creeks [bb]	.....	.....	.....	....	103	700,000,000
32	Municipal	1866	1866	Creeks	52,800	Iron pipe	52,800	36	265	335,000,000
33	Municipal	1847	1854	Creeks [cc]	[dd]....	Iron pipe	93,362	[ee]...	300	2,500,000,000
34	Private	1853	1857	Creeks [ff]	30	.....	.....	....	110	2,228,000,000

[a] Not reported. [b] 8 and 10. [c] 20 and 24. [d] 14 and 16. [e] 12 and 8. [f] Also springs. [g] Also lake. [h] 50 feet of 8-inch; 2590 feet of 6-inch. [i] 24, 20, and 16. [k] 4189 feet of 18-inch; 22,411 feet 16-inch; 26,168 feet 12-inch. [l] Two sources, 26,780 and 11,941 feet. [m] 26,780 feet of 20-inch, and 30,648 feet of 12-inch.

EQUIPMENT AND APPARATUS OWNED — PRIVATE PLANTS (First Part).

KIND OF DISTRIBUTION.															
Reservoir.			Tank.					Standpipe.				Direct Pumping.			
					Dimen'ns.					Dimen'ns.		Pressure.			
Number in use.	Head of Water, feet.	Total storage capacity, gallons.	Number in use.	Head of Water, feet.	Diameter, feet.	Height, feet.	Total storage capacity, gallons.	Number in use.	Head of Water, feet.	Diameter, feet.	Height, feet.	Ordinary Service.	Fire Service.	Total daily capacity, gallons.	Plant number.
....	....	.....	....	....	....	....	.....	....	....	....	....	....	....	.....	1
....	....	.....	....	....	....	....	.....	....	....	....	....	....	....	.....	2
....	....	.....	2	150	[n]...	[d]...	87,047	....	....	....	....	....	....	.....	3
....	....	.....	....	....	....	....	.....	....	....	....	....	....	....	.....	4
....	....	.....	....	....	....	....	.....	....	....	....	....	....	....	.....	5
....	....	.....	....	....	....	....	.....	....	....	....	....	....	....	.....	6
....	....	.....	....	....	....	....	.....	....	....	....	....	....	....	.....	7
....	....	.....	....	...	....	....	.....	....	....	....	....	....	....	.....	8
....	....	.....	....	....	....	....	.....	....	....	....	....	....	....	.....	9
....	....	.....	....	....	....	....	.....	....	....	....	....	....	....	.....	10
....	....	.....	....	....	....	....	.....	....	....	....	....	....	....	.....	11
....	....	.....	....	...	....	....	.....	....	....	....	....	....	...	.....	12
....	....	.....	....	....	....	....	.....	....	....	....	....	....	....	.....	13
....	....	.....	....	....	...	....	.....	....	....	....	....	....	....	.....	14
....	....	.....	....	....	....	....	.....	....	....	....	....	....	....	.....	15
....	....	.....	....	...	...	....	.....	1	413	30	60	....	....	.....	16
....	....	.....	....	....	....	....	.....	...	....	....	....	....	....	.....	17
1	150	5,000,000	....	....	...	....	.....	....	....	....	....	130	180	4,250,000	18
1	172	2,154,300	....	....	....	....	.....	....	....	....	....	....	....	.....	19
....	....	.....	1	200	40	40	376,013	....	....	....	....	....	....	.....	20
....	....	.....	....	....	....	....	.....	....	....	....	....	....	....	.....	21
....	....	.....	....	....	....	....	.....	....	....	....	....	....	....	.....	22
....	....	.....	....	....	....	....	.....	....	....	....	....	....	....	.....	23
....	....	.....	....	....	....	....	.....	....	....	....	....	....	....	.....	24
....	....	.....	....	....	....	....	.....	....	....	....	....	....	....	.....	25
....	....	.....	....	....	....	....	.....	....	....	...	....	....	....	.....	26
....	....	.....	....	....	....	....	.....	....	....	....	....	....	....	.....	27
....	....	.....	1	155	25	26	95,472	....	....	....	....	....	....	.....	28
....	....	.....	....	....	....	....	.....	....	....	....	....	....	....	.....	29
....	....	.....	....	....	....	....	.....	....	....	....	....	....	....	.....	30
1	291	18,000,000	....	....	....	...	.....	....	....	....	....	....	....	.....	31
....	....	.....	....	....	....	....	.....	....	....	....	....	....	....	.....	32
1	175	8,000,000	....	....	....	....	.....	....	....	....	....	....	....	.....	33
1	110	4,000,000	....	....	....	....	.....	....	....	....	....	....	....	.....	34

[n] 240 and 199. [o] Also creeks and lake. [p] Tile, Scotch clay, and iron pipe. [q] 10, 12, 16, 20, and 24.
[r] 178 and 130. [s] 24 and 12. [aa] 24 and 16. [bb] Also lake. [cc] Also lake and river. [dd] 29,040 and 200.
[ee] 30 and 20. [ff] Also river.

TABLE II. WATER WORKS: PLANT, DISTRIBUTING AND MUNICIPAL

Plant number.	Ownership.	Kind of filters in use.	PUMPING EQUIPMENT.							
			STEAM POWER PLANT.				WATER POWER PLANT.			
			Boilers.		Pumps.		Water Wheels.		Pumps.	
			Number.	Total rated capacity, H. P.	Number.	Total rated capacity, gallons.	Number.	Total rated capacity, H. P.	Number.	Total rated capacity, gallons.
1	Private	.....	....	....	....	.....	....	....	....	.....
2	Private	.....	....	...	....	.....	....	....	....	.....
3	Private	.....	1	10	1	25,000	[a].....	[a].....	[b]....2	[b] 30,000
4	Private	.....	....	....	....	.....	....	....	....	.....
5	Private	.....	....	....	....	.....	....	....	....	.....
6	Private	.....	....	....	....	.....	....	....	....	.....
7	Private	.....	....	....	....	.....	....	....	....	.....
8	Private	.....	....	....	....	.....	....	....	....	.....
9	Private	.....	....	....	....	.....	....	....	....	.....
10	Private	.....	....	....	....	.....	....	....	....	.....
11	Private	.....	....	....	....	.....	....	....	....	.....
12	Municipal	Sand	....	....	....	.....	....	....	....	.....
13	Private	.....	....	....	....	.....	....	....	....	.....
14	Private	Sand	....	....	....	.....	....	....	....	.....
15	Private	.....	....	....	....	.....	....	....	....	.....
16	Private	.....	....	....	....	.....	[c].....	[c].....	1	200,000
17	Private	.....	....	....	....	.....	....	....	....	.....
18	Municipal	.....	2	80	1	2,250,000	2	[a].....	2	2,000,000
19	Private	.....	1	56	1	1,128,700	1	48	1	752,450
20	Private	.....	2	140	1	1,000,000	....	....	....	.....
21	Private	.....	....	....	....	.....	....	....	....	.....
22	Private	.....	....	....	....	.....	....	....	....	.....
23	Municipal	Mechanical	....	....	....	.....	...	....	....	.....
24	Municipal	.....	....	....	....	.....	....	....	....	.....
25	Municipal	.....	....	....	....	.....	....	....	....	.....
26	Municipal	.....	....	....	....	.....	....	....	....	.....
27	Private	.....	....	....	....	.....	....	....	....	.....
28	Municipal	.....	....	....	....	.....	[a].....	[a].....	1	150,000
29	Municipal	.....	....	....	....	.....	....	....	....	.....
30	Municipal	.....	....	....	....	.....	....	....	....	.....
31	Municipal	.....	2	160	1	5,000,000	....	....	....	.....
32	Municipal	.....	....	....	....	.....	....	....	....	.....
33	Municipal	.....	1	150	1	350,000	....	....	....	.....
34	Private	.....	3	300	2	14,000,000	....	....	....	.....

[a] Not reported [b] Including one wind power pump, capacity 20,000 gallons. [c] Power rented.

EQUIPMENT, AND APPARATUS OWNED—PRIVATE PLANTS (Second Part).

DISTRIBUTING SYSTEM.													
Mains. Size (diameter, inches).			Total length in miles.	Fire Hydrants.	Water Motors.		Hydraulic Elevators.		Meters.				Plant number.
										Size.			
Largest.	Smallest.	Average.			Number.	Total rated capacity, H. P.	Number.	Total capacity, gallons.	Number.	Largest.	Smallest.	Average.	
12.00	4.00	7.65	1.00	11	....	....	....	....	....	....	....	....	1
12.00	6.00	8.65	8.00	42	....	....	....	....	....	....	....	....	2
5.00	3.00	4.08	2.95	15	....	....	....	....	....	....	....	....	3
6.00	4.00	5.36	1.25	38	....	....	....	....	....	....	....	....	4
12.00	1.00	6.02	7.40	35	....	....	....	....	50	1.50	1.00	1.27	5
12.00	4.00	7.92	8.28	42	3	1	....	....	6	2.00	1.00	1.22	6
4.00	1.00	2.02	3.91	6	3	1½	....	....	....	....	....	....	7
12.00	4.00	6.47	8.13	54	....	....	....	....	5	4.00	.50	2.07	8
8.00	1.00	4.14	2.52	17	....	....	....	....	2	1.50	.75	1.19	9
8.00	4.00	6.03	7.14	30	....	....	....	....	1	2.00	2.00	2.00	10
10.00	4.00	7.85	7.00	34	6	6	....	....	....	....	....	....	11
10.00	4.00	5.97	13.08	80	....	....	....	....	....	....	...	....	12
12.00	4.00	6.69	18.19	33	....	....	....	....	10	2.00	1.50	1.82	13
6.00	1.50	3.85	8.38	36	6	½	1	30	1	2.00	2.00	2.00	14
8.00	1.00	5.01	15.04	43	[a]....	[a]....	..	....	10	.75	.75	.75	15
20.00	6.00	8.38	16.70	151	....	....	....	....	151	3.00	.50	.72	16
12.00	1.00	7.19	14.20	84	2	¾	....	....	25	1.50	.75	1.04	17
14.00	6.00	7.59	20.95	184	6	1	4	180	500	3 00	.50	.68	18
12.00	.75	7.15	15.89	118	4	1½	....	....	27	4.00	.63	1.63	19
12.00	4.00	8.43	19.70	75	....	....	....	....	1	2.00	2.00	2.00	20
12.00	4.00	6.95	10.95	77	5	5	3	[a]....	193	3.00	.38	.87	21
10.00	.75	6.69	19.71	100	1	3	5	450	20	3.00	.63	1.47	22
12.00	1.00	5.77	19.99	173	....	....	2	100	....	....	....	....	23
18.00	.75	9.10	22.50	110	7	1¾	....	....	69	6.00	.63	1.62	24
10.00	1.00	5.61	16.18	158	....	....	....	....	76	4.00	.63	2.04	25
12.00	1.00	8.14	22.26	174	....	....	1	[a]....	64	3.00	.63	1.51	26
16.00	4.00	7.12	21.78	82	3	6	....	....	38	6.00	.38	1.46	27
20.00	3.00	8.16	33.65	221	[a]....	[a]....	6	[a]....	197	3.00	.50	1.18	28
20.00	4.00	8.26	58.91	366	....	....	....	....	166	6.00	.50	1.71	29
14.00	.75	6.98	36.43	362	22	12	10	[a]....	89	6.00	.50	1.87	30
16.00	.75	6.49	38.14	296	5	2	[a]....	[a]....	124	6.00	.50	1.81	31
24.00	1.00	7.67	43.99	380	18	10	22	[a]....	341	4.00	.63	1.32	32
24.00	1.50	7.47	96.68	769	....	....	....	....	497	4.00	.50	1.45	33
36.00	6.00	12.35	85.67	466	....	....	....	....	141	6.00	.75	2.56	34

TABLE III. WATER WORKS: INVESTMENT

Plant number.	Ownership.	Land.		Construction for storage at source of supply.		Wells.		Conduits.		Buildings.		Pumping Equipment.	
		Cost.	Per cent. of total investment.	Cost.	Per cent. of total investm't	Cost.	Per cent. of total investment.	Cost.	Per cent. of total investment.	Cost.	Per cent. of total investment.	Cost.	Per cent. of total investment.
1	Private	$100	4.00	$300	12.00	$....	....	[a]....	[a]..	....	...	....	...
2	Private	3,500	4.38	500	.62	....	....	[a]....	[a]..	$150	0.19	....	...
3	Private	500	2.50	.....	...	...	....	....	...	1,000	5.00	$6,500	32.50
4	Private	500	1.73	7,500	25.86	....	....	$12,500	43.10	....	...	....	...
5	Private	3,678	5.32	38,633	55.92	....	....	....	...	2,000	2.90	....	...
6	Private	4,000	8.90	8,000	17.81	....	....	[a]....	[a]..	....	...	...	...
7	Private	100	1.40	3,000	42.11	....	....	2,250	31.58	....	...	....	...
8	Private	20,000	35.75	6,000	10.72	....	....	12,000	21.45	....	...	....	...
9	Private	700	2.32	6,000	19.90	....	....	7,500	24.88	....	...	....	...
10	Private	1,800	5.64	6,000	18.80	....	....	[a]....	[a]..	....	...	....	...
11	Private	10,000	20.00	4,070	8.14	....	....	[a]....	[a]..	....	...	....	...
12	Municipal	3,000	7.36	12,500	30.69	....	....	7,500	18.41	....	...	....	...
13	Private	5,000	4.75	17,005	16.16	....	....	[a]....	[a]..	300	.28	....	...
14	Private	7,648	8.38	57,984	63.50	....	....	[a]....	[a]..	300	.33	....	...
15	Private	1,500	1.87	15,800	19.75	....	....	2,640	3.30	2,500	3.13	....	...
16	Private	96,357	42.48	30,000	13.23	....	...	....	...	....	...	1,000	.44
17	Private	7,619	4.19	28,643	15.75	....	....	....	...	....	...	....	...
18	Municipal	7,758	3.54	49,778	22.74	....	....	....	...	7,049	3.22	11,577	5.29
19	Private	[e] 13,077	[f]...	21,588	8.04	....	....	....	...	[g]10,467	[h]..	13,314	4.96
20	Private	2,000	2.06	.....	...	....	....	500	.51	3,000	3.09	4,000	4.11
21	Private	[i]....	[i]...	[i].....	[i]..	....	....	[i] ...	[i]..	[i]....	[i]..	....	..
22	Private	7,000	4.60	44,000	28.94	....	....	....	...	600	.40	....	...
23	Municipal	4.469	1.36	139,141	42.31	....	....	35,000	10.64	570	.17	....	...
24	Municipal	25,000	11.98	11,630	5.57	....	....	[a]....	[a]..	3,729	1.79	....	...
25	Municipal	17,749	6.33	131,932	47.07	....	....	75,000	26.76	....	...	....	.
26	Municipal	15,000	2.74	148,000	27.00	....	....	125,000	22.80	2,285	.42	....	...
27	Private	2,312	1.56	17,600	11.86	....	....	[a]....	[a]..	....	...	....	...
28	Municipal	62,669	9.95	48,852	7.76	...	....	153,255	24.34	1,100	.18	5,000	.79
29	Municipal	83,704	16.38	35,974	7.04	....	....	125,000	24.46	1,545	.30	....	...
30	Municipal	51,344	9.45	187,913	34.58	....	....	64,468	11.86	300	.05	....	...
31	Municipal	[aa]....	[aa]..	[aa]....	[aa]..	....	....	[aa]....	[aa]..	[aa]...	[aa]..	[aa]....	[aa]..
32	Municipal	31,610	2.39	295,000	22.28	....	....	500,000	37.77	3,000	.23	....	...
33	Municipal	183,618	6.56	1,026,280	36.68	....	....	471,425	16.85	46,500	1.66	30,725	1.10
34	Private	150,000	7.78	503,000	26.09	....	....	....	...	50,000	2.59	30,000	1.56

[a] Included in cost of mains. [b] Including cost of conduit. [c] Not obtainable for reason stated in note [b].
[d] Hydrants donated. [e] Cost of land for buildings included in cost of buildings.

—PRIVATE AND MUNICIPAL PLANTS.

Distributing reservoirs, stand pipes, and tanks.		Filters and filtration beds.		Mains.		Meters and Hydrants.		Teams, tools, and other accessories.		Total investment.	Plant number.
Cost.	Per cent. of total investm't	Cost.	Per cent. of total investment.	Cost.	Per cent. of total investment.	Cost.	Per cent. of total investment.	Cost.	Per cent. of total investm't		
....	....	.....	....	[b] $2,000	[e]...	[d]....	[d]...	$100	4.00	$2,500	1
....	....	.....	....	[b] 73,920	[e]...	$1,680	2.10	250	.31	80,000	2
$3,500	17.50	.....	....	6,500	32.50	1,500	7.50	500	2.50	20,000	3
....	....	.....	....	6,780	23.38	1,600	5.52	120	.41	29,000	4
....	....	.....	....	21,000	30.40	2,475	3.58	1,300	1.88	69,086	5
....	....	.....	....	[b] 31,020	[e]...	1,800	4.01	100	.22	44,920	6
....	....	.....	....	1,600	22.46	150	2.10	25	.35	7,125	7
....	....	.....	....	16,273	29.09	1,620	2.90	50	.09	55,943	8
....	....	.....	....	15,275	50.66	575	1.91	100	.33	30,150	9
....	....	.....	....	[b] 23,120	[e]...	995	3.12	....	..	31,915	10
....	....	.....	....	[b] 35,000	[e]...	930	1.86	....	..	50,000	11
....	....	$6,500	15.96	8,437	20.71	2,800	6.87	....	..	40,737	12
....	....	.....	....	[b] 82,632	[e]...	216	.21	50	.05	105,203	13
....	....	600	.66	[b] 23,176	[e]...	1,497	1.64	100	.11	91,305	14
....	....	.....	....	52,000	65.00	1,530	1.91	4,030	5.04	80,000	15
5,000	2.21	.....	....	85,861	37 85	8,603	3.79	....	..	226,821	16
....	....	.....	....	137,702	75.73	5,789	3.18	2,080	1.15	181,833	17
31,633	14.45	.....	....	98,819	45.14	10,304	4.71	2,000	.91	218,918	18
15,399	5.73	... ..	....	185,010	68.87	9,092	3.38	677	.25	268,624	19
3,800	3.91	.....	....	80,513	82.82	3,000	3.09	400	.41	97,213	20
....	....	.....	....	[i].....	[i]...	[i]....	[i]...	[i]....	[i]..	179,998	21
....	....	.....	....	95,442	62.77	3,000	1.97	2,000	1.32	152,042	22
....	....	3,720	1.13	135,725	41.27	9,663	2.94	600	.18	328,888	23
....	....	.....	....	[b] 162,606	[e]...	5,751	2.75	....	..	208,716	24
....	....	.....	....	44,319	15.81	11,200	4.00	100	.03	280,300	25
....	....	.....	....	242,667	44.27	10,180	1.86	5,000	.91	548,132	26
....	....	.....	....	[b] 125,513	[e]...	2,715	1.83	200	.14	148,340	27
10,647	1.69	.....	....	328,598	52.18	16,792	2.67	2,800	.44	629.713	28
....	....	.....	....	239,074	46.77	22,250	4.35	3,600	.70	511,147	29
....	....	.....	....	207,903	38.25	15,146	2.79	16,402	3.02	543,476	30
[aa]...	[aa]...	.....	....	[aa].....	[aa]...	[aa]....	[aa]...	....	..	631,000	31
....	....	.....	....	465,228	35.14	22,638	1.71	6,375	.48	1,323,851	32
89,193	3.19	.....	....	858,320	30.68	86,000	3.07	6,000	.21	2,798,061	33
10,000	.52	.....	....	1,160,134	60.17	23,000	1.19	2,000	.10	1,928,134	34

[f] Not obtainable for reason stated in note [e]. [g] Including cost of land for buildings.
[h] Not obtainable for reason stated in note [g]. [i] Not reported. [aa] Not reported.

TABLE IV. WATER WORKS: SOURCES OF FUNDS USED IN THE INVESTMENT—MUNICIPAL PLANTS.

Plant number.	Total investment.	Amount derived from			BONDS.					
		Taxation.	Transfers from funds on hand.	Issue of bonds.	Total amount outstanding.	Date of issue.	Date of maturity.	Rate per cent. of interest.	Coin or gold.	Amount per $100 par, realized from sale.
12	$40,737	....	$737	$40,000	$32,000	[a]..	[b]..	[c]..	Coin	$100.00
18	218,918	....	[d]....	[d]....	200,000	1885	[e]..	4..	Coin	[d]
23	328,888	$25,000	[f] 178,888	125,000	97,500	[g]..	[h]..	[c]..	Coin	[j]
24	208,716	....	31,091	177,625	175,000	[k]..	[l]..	4..	Coin	101.50
25	280,300	....	[f] 80,300	200,000	200,000	[m]..	[n]..	4..	Coin	[d]
26	548,132	....	[f] 121,132	427,000	297,000	[o]..	[p]..	[q]..	Coin	[r]
28	629,713	29,000	159,206	441,507	426,000	[s]..	[t]..	[u]..	Legal tender.	103.64
29	511,147	....	11,147	500,000	284,000	[v]..	[w]..	[x]..	Coin	100.00
30	543,476	....	243,476	300,000	300,000	[y]..	[z]..	[aa]..	Coin	100.00
31	631,000	....	[f] 46,000	585,000	320,000	[bb]..	[cc]..	[dd]..	Coin	[ee]
32	1,323,851	[f] 358,851	....	965,000	770,000	[ff]..	[gg]..	[hh]..	Coin	[ii]
33	2,798,061	324,257	723,804	1,750,000	925,000	[jj]..	[kk]..	[ll]..	[mm]..	100.00

[a] Two issues; 1878 and 1896.
[b] 1898 to 1908; 1915 to 1925.
[c] 6 and 4.
[d] Not reported.
[e] 1899 to 1914.
[f] Including premium derived from sale of bonds.
[g] Two issues; 1861 and 1896.
[h] 1891 and 1927.
[j] $100.00 and $102.50.
[k] Two issued; 1882 and 1894.
[l] 1912 and 1924.
[m] Seven issues; 1875 to 1895.
[n] 1900 to 1925.
[o] Four issues; 1866, 1883, 1894, 1897.
[p] 1896, 1908, 1910, 1922.
[q] 6, 4, 3 65-100, and 4.
[r] First and third issues, $100.00; second, $103.05; fourth, $107.50.
[s] Three issues; 1870, 1889, 1894.
[t] 1900, 1919, 1924.
[u] First issue, 7; others, 4.
[v] Six issues; 1857 to 1893.
[w] 1887 to 1918.
[x] First three issues, 7; last three, 4.
[y] Three issues; 1868, 1869, 1870.
[z] 1898, 1908, 1910.
[aa] First issue, 6; second and third, 5.
[bb] Three issues; 1869, refunded 1889; 1893, 1895.
[cc] First issue not reported; second, 1901 to 1911; third, 1911 to 1913.
[dd] First issue, 7; refunded at 3½; second and third, 4.
[ee] $100.00; $101.03; $101.05.
[ff] Four issues; 1867, 1880, 1894, and 1895.
[gg] 1897 to 1899; 1905, 1919; 1920.
[hh] First issue, 7; second, 4½; third and fourth, 4.
[ii] First and second issues, $100.00; third, $101.68; fourth, $104.25.
[jj] Eleven issues; 1865 to 1893.
[kk] 1890 to 1918.
[ll] First four issues, 7; fifth, 6; sixth to ninth, 5; last two, 4.
[mm] First nine issues, coin; last two, gold.

TABLE V. WATER WORKS: GROSS INCOME — PRIVATE AND MUNICIPAL PLANTS.

Plant number.	Ownership.	From Sales of Water.						From rents and sales of meters.		From permits for tapping street mains.		From all other sources.		Total gross income.
		By Meters.		By Contract.		Total								
		Amount.	Per ct. of total gross income.	Amount.	Per ct. of total gross income.	Amount.	Per ct. of total gross income.	Amount.	Per ct. of total gross income.	Amount.	Per ct. of total gross income	Amount.	Per ct. of total gross income.	
1	Private	....	....	$703	100.00	$703	100.00	....	....	....	....	....	....	$703
2	Private	....	....	3,590	100.00	3,590	100.00	....	....	....	....	....	....	3,590
3	Private	....	....	2,440	100.00	2,440	100.00	....	....	....	....	....	....	2,440
4	Private	....	....	2,140	100.00	2,140	100.00	....	....	....	....	....	....	2,140
5	Private	$850	9.48	8,118	90.52	8,968	100.00	....	....	....	....	....	....	8,968
6	Private	469	10.31	4,064	89.38	4,533	99.69	$14	0.31	....	....	....	....	4,547
7	Private	....	....	1,813	100.00	1,813	100.00	....	....	....	...	....	....	1,813
8	Private	270	3.72	6,991	96.28	7,261	100.00	....	....	....	....	....	....	7,261
9	Private	125	3.50	3,443	96.50	3,568	100.00	....	....	....	....	....	....	3,568
10	Private	350	8.80	3,629	91.20	3,979	100.00	....	....	....	....	....	....	3,979
11	Private	....	....	4,445	100.00	4,445	100.00	....	....	....	....	....	....	4,445
12	Municipal	....	....	5,726	100.00	5,726	100.00	....	....	....	....	....	....	5,726
13	Private	2,500	20.81	9,516	79.19	12,016	100.00	....	....	....	....	....	....	12,016
14	Private	756	9. 0	7,120	90.40	7,876	100.00	....	....	....	....	....	....	7,876
15	Private	480	6.25	6,996	91.08	7,476	97.33	...	....	....	....	$205	2.67	7,681
16	Private	1,944	12.53	13,371	86.19	15,315	98.72	198	1.28	....	....	....	....	15,513
17	Private	2,583	27.03	6,918	72.39	9,501	99.42	....	....	....	....	56	.58	9,557
18	Municipal	6,000	53.44	5,028	44.78	11,028	98.22	9	.08	....	....	191	1.70	11,228
19	Private	3,931	28.02	10,100	71.98	14,031	100.00	....	....	....	....	....	....	14,031
20	Private	300	2.22	13,010	96.26	13,310	98.48	12	.09	....	....	194	1.43	13,516
21	Private	5,157	27.85	12,978	70.09	18,135	97.94	....	....	....	....	382	2.06	18,517
22	Private	1,650	9.35	13,941	79.04	15,591	88.39	....	....	....	....	2,048	11.61	17,639
23	Municipal	....	....	9,346	97.54	9,346	97.54	....	....	....	....	236	2.46	9,582
24	Municipal	5,000	35.26	9,057	63.86	14,057	99.12	....	....	....	....	125	.88	14,182
25	Municipal	4,904	24.52	14,873	74.36	19,777	98.88	....	....	....	....	225	1.12	20,002
26	Municipal	2,437	8.27	25,330	85.95	27,767	94.22	....	....	....	....	1,704	5.78	29,471
27	Private	3,240	17.31	15,481	82.69	18,721	100.00	....	....	....	....	....	....	18,721
28	Municipal	14,131	33.18	28,452	66.82	42,583	100.00	....	....	....	....	....	....	42,583
29	Municipal	11,137	26.65	28,654	68.57	39,791	95.22	395	.94	....	....	1,602	3.84	41,788
30	Municipal	6,406	12.52	43,841	85.69	50,247	98.21	....	....	....	....	918	1.79	51,165
31	Municipal	7,150	13.12	46,930	86.14	54,080	99.26	....	....	....	....	404	.74	54,484
32	Municipal	35,917	34.77	67,385	65.23	103,302	100.00	....	....	....	....	....	....	103,302
33	Municipal	61,560	28.61	147,513	68.55	209,073	97.16	....	....	....	....	6,117	2.84	215,190
34	Private	22,827	11.37	177,353	88.38	200,180	99.75	....	....	....	....	500	.25	200,680

TABLE VI. WATER WORKS: COST OF PRODUCTION

Plant number.	Ownership.	Report for the year ending	GENERAL EXPENSES.							
			Salaries of officers, superintendents, clerks, etc.	Office supplies and expenses.	Insurance.	Legal expenses and damages.	Licenses and royalties.	Other.	Total.	Per cent. of total cost of production.
1	Private	Dec. 1, 1897	$10	$5	....	....	....	....	$15	2.94
2	Private	June 30, 1897	[a] 400	25	....	....	....	....	[a] 425	[b]....
3	Private	Jan. 1, 1897	[e]....	25	....	....	....	....	[f] 25	[g]....
4	Private	[j].....	[a] 100	42	....	....	....	$8	[a] 150	[b]....
5	Private	May 18, 1897	[a] 600	631	....	....	....	....	[a] 1,231	[b]....
6	Private	Jan. 31, 1898	[a] 300	10	....	....	....	222	[a] 532	[b]....
7	Private	Apr. 1, 1898	50	23	....	....	...	....	73	30.29
8	Private	Feb. 28, 1899	[a] 400	135	....	$104	....	....	[a] 639	[b]....
9	Private	Nov. 30, 1897	40	19	....	....	....	....	59	7.13
10	Private	June 30, 1897	400	5	....	....	...	....	405	31.82
11	Private	Jan. 1, 1898	100	10	....	....	....	....	110	7.26
12	Municipal	March 31, 1898	425	30	....	....	....	....	455	76.99
13	Private	Dec. 31, 1897	[a] 1,796	200	$10	....	....	....	[a] 2,006	[b]....
14	Private	July 31, 1897	600	165	....	600	...	....	1,365	37.91
15	Private	Oct. 1, 1897	1,200	30	11	182	....	....	1,423	45.46
16	Private	Oct. 1, 1897	400	350	....	....	....	....	750	22.45
17	Private	Dec. 31, 1897	[a] 1,075	62	....	8	....	50	[a] 1,195	[b]....
18	Municipal	Oct. 31, 1897	1,200	63	90	....	....	227	1,580	8.97
19	Private	Dec. 31, 1897	1,275	99	125	6	....	42	1,547	24.51
20	Private	Dec. 31, 1896	870	50	20	....	....	....	940	10.40
21	Private	Dec. 31, 1897	1,550	536	9	165	....	350	2,610	30.42
22	Private	Jan. 1, 1898	1,800	136	8	160	....	30	2,134	8.46
23	Municipal	May 1, 1898	962	37	....	....	....	....	999	28.13
24	Municipal	Nov. 1, 1897	[a] 450	175	....	46	....	12	[a] 683	[b]....
25	Municipal	Jan. 1, 1898	[a] 1,250	191	....	....	....	....	[a] 1,441	[b]....
26	Municipal	Dec. 31, 1898	1,980	192	30	....	....	....	2,202	28.01
27	Private	Feb. 28, 1897	[a] 3,000	75	....	....	....	50	[a] 3,125	[b]....
28	Municipal	Sept. 1, 1897	1,950	610	4	1,964	....	12	4 540	40.02
29	Municipal	March 31, 1898	2,900	880	10	....	....	393	4,183	32.77
30	Municipal	March 31, 1897	2,800	720	7	400	....	275	4,202	40.32
31	Municipal	Dec. 31, 1897	2,300	316	33	....	....	72	2,721	15.97
32	Municipal	Nov. 30, 1898	4,325	425	44	....	....	300	5,094	26.46
33	Municipal	March 1, 1898	11,000	2,620	75	....	....	....	13,695	20.86
34	Private	Nov. 30, 1897	11.120	1,994	....	....	....	....	13,114	20.38

[a] Including wages. [b] Not obtainable for reasons stated in note [a]. [c] Included in salaries of officers, superintendents, clerks, etc. [d] Not obtainable for reasons stated in note [c]. [e] Included in wages. [f] Not including salaries of officers, superintendents, clerks, etc. [g] Not obtainable for reasons stated in note [f]. [h] Including salaries of officers, superintendents, clerks, etc.

—PRIVATE AND MUNICIPAL PLANTS (First Part).

Wages.		Supplies.						Rebates and worthless bills.	Maintenance. Actual disbursements for repairs and renewals.				Plant number.
									On storage constructions at source of supply well and conduits		On Buildings.		
Total.	Per cent. of total cost of production.	Fuel.	Pumping station supplies.	Filtration supplies.	Other.	Total.	Per cent. of total cost of production.		Amount	Per ct. of cost.	Amount	Per ct. of cost.	
$25	4.90	....	....	....	....	....	....	....	....	....	....	....	1
[c].....	[d].....	....	....	....	....	....	....	....	....	....	....	....	2
[h] 150	[i].....	$20	$30	....	$25	$75	4.36	....	....	....	....	....	3
[c].....	[d].....	....	....	....	....	....	....	....	....	....	....	....	4
[c].....	[d].....	....	....	....	....	....	....	....	....	....	....	....	5
[c].....	[d].....	....	....	....	....	....	....	....	....	....	....	....	6
150	62.24	....	....	....	....	....	....	....	....	....	....	....	7
[c].....	[d].....	....	....	....	18	18	2.48	$14	....	....	....	....	8
175	21.13	....	....	....	75	75	9.06	....	$100	.74	....	....	9
200	15.71	....	....	....	....	....	....	....	25	[k]....	....	....	10
300	19.79	....	....	....	46	46	3.03	....	10	[k]....	....	...	11
25	4.23	....	....	$15	....	15	2.54	....	....	....	....	....	12
[c].....	[d].....	....	....	....	69	69	1.36	18	3,000	[k]....	....	....	13
20	.55	....	....	....	10	10	.28	10	....	....	....	....	14
427	13.64	....	....	....	130	130	4.15	100	....	....	....	....	15
[l]....	[m]....	....	[l]....	....	105	[l] 405	[m]....	....	604	2.01	....	....	16
[c].....	[d].....	....	....	....	....	....	....	....	12	.04	....	....	17
3,139	17.83	580	412	....	53	1,045	5.93	....	....	....	....	....	18
374	5.92	239	32	....	....	271	4.29	....	160	.74	$49	[n]....	19
600	6.64	1,625	483	....	1,600	3,708	41.04	300	75	15.00	....	....	20
32	.37	....	....	....	95	95	1.11	....	214	[n]....	....	....	21
780	3.09	....	....	....	200	200	.79	100	13,221	30.05	....	....	22
16	.45	....	....	....	107	107	3.01	....	600	.34	....	....	23
[c].....	[d].....	....	....	....	45	45	2.21	....	....	....	....	....	24
[c].....	[d].....	....	...[j]	....	288	288	8.41	15	35	.02	....	....	25
400	5.09	....	....	....	770	770	9.80	....	1,713	.63	....	....	26
[c].....	[d].....	....	....	....	290	290	2.70	....	....	....	...	....	27
424	3.74	....	5	....	....	5	.04	....	313	.15	....	....	28
1,108	8.68	....	....	....	247	247	1.93	....	4,550	2.83	...	....	29
69	.66	....	....	....	605	605	5.81	....	139	.06	6	2.00	30
2,760	16.19	2,325	496	....	768	3,589	21.06	....	....	....	....	....	31
1,800	9.35	....	....	....	3,186	3,186	16.55	....	40	.01	24	.80	32
3,900	5.94	....	....	....	5,100	5,100	7.77	400	7,225	.48	350	.75	33
2,315	3.60	1,843	32	....	....	1,875	2.91	....	....	....	....	....	34

[i] Not obtainable for reasons stated in note [h]. [j] Not reported. [k] Not obtainable; cost of conduits not reported. [l] Pumping done by contract; the amount paid for same is included in total supplies, but cannot be distributed among the various items. [m] Not obtainable for reasons stated in note [l]. [n] Not obtainable; cost not reported.

TABLE VI. WATER WORKS: COST OF PRODUCTION

Plant number.	Ownership.	MAINTENANCE— Actual disbursements for repairs and renewals — Concluded.										
		On pumping equipment.		On distributing reservoir, stand-pipes and tanks.		On filters and filtration beds.		On mains and other distributing equipment.		Other.	Total.	Per cent. of total investment exclusive of land.
		Amount	Perct of cost	Amount	Perct. of cost	Amount	Perct. of cost	Amount	Perct. of cost			
1	Private	....	....	....	....	....	....	$350	[a]...	....	$350	14.58
2	Private	....	....	....	....	....	....	100	[a]...	....	100	.13
3	Private	....	....	$1,250	35.71	....	....	25	.31	....	1,275	6.54
4	Private	....	....	....	....	....	....	80	.95	$20	100	.35
5	Private	....	....	....	....	....	....	816	3.48	....	816	1.25
6	Private	....	....	....	....	....	....	....	....	....	....	....
7	Private	....	....	....	....	....	....	....	....	....	....	....
8	Private	....	....	....	....	....	....	55	.31	....	55	.15
9	Private	....	....	....	....	....	....	125	.79	....	225	.76
10	Private	....	....	....	....	....	....	41	[a]...	....	66	.22
11	Private	....	....	....	....	....	....	250	[a]...	....	260	.65
12	Municipal	....	....	....	....	....	....	....	....	....	....	....
13	Private	....	....	....	....	....	....	....	....	....	3,000	2.99
14	Private	....	....	....	....	$20	3.33	176	[a]...	....	196	.23
15	Private	....	....	....	....	....	....	1,050	1.96	....	1,050	1.34
16	Private	....	....	10	.20	....	....	761	.81	116	1,491	1.14
17	Private	....	....	....	....	....	....	103	.07	....	115	.07
18	Municipal	$154	1.33	....	....	....	....	1,135	1.04	....	1,289	.61
19	Private	25	.19	66	.43	....	....	263	.14	....	563	[c]....
20	Private	575	14.38	125	3.29	....	....	584	.70	225	1,584	1.66
21	Private	....	....	....	....	....	....	1,580	[a]...	....	1,794	[c]....
22	Private	....	....	....	....	....	....	1,191	1.21	350	14,762	10.18
23	Municipal	....	....	....	....	95	2.55	653	.45	182	1,530	.47
24	Municipal	....	....	....	....	....	....	1,309	[a]...	....	1,309	.71
25	Municipal	....	....	....	...	....	....	432	.78	600	1,067	.41
26	Municipal	....	....	....	....	....	....	247	.10	551	2,511	.47
27	Private	....	....	....	....	....	....	40	[a]...	....	40	.03
28	Municipal	32	.64	1	.01	....	....	1,590	.46	9	1,945	.34
29	Municipal	....	....	....	....	....	....	....	....	623	5,179	1.21
30	Municipal	....	....	....	....	....	....	1,817	.81	695	2,657	.54
31	Municipal	906	[aa]....	....	....	....	....	7,067	[aa]...	....	7,973	[bb]...
32	Municipal	....	....	....	....	....	....	1,051	.22	4,273	5,388	.42
33	Municipal	100	.33	109	.12	....	....	9,174	.97	14,880	31,838	1.22
34	Private	75	.25	....	....	....	....	11,411	.96	....	11,486	.65

[a] Not obtainable; cost not reported. [b] Exempt from taxation.
[c] Not obtainable; total investment exclusive of land not reported.

—PRIVATE AND MUNICIPAL PLANTS (Second Part).

Concluded.										
Estimated depreciation on cost of works exclusive of land.		Total.			Total cost of production.		Taxes.	Total cost of production and taxes.		Plant number.
Total.	Per ct. of total investment exclusive of land.	Amount.	Per cent. of total investment exclusive of land.	Per cent. of total cost of production.	Including estimated depreciation.	Excluding estimated depreciation.	Total.	Including estimated depreciation.	Excluding estimated depreciation.	
$120	5.00	$470	19.58	92.16	$510	$390	$31	$541	$421	1
2,325	3.04	2,425	3.17	85.09	2,850	525	530	3,380	1,055	2
195	1.00	1,470	7.54	85.47	1,720	1,525	40	1,760	1,565	3
92	.32	192	.67	56.14	342	250	94	436	344	4
1,308	2.00	2,124	3.25	63.31	3,355	2,047	450	3,805	2,497	5
2,046	5.00	2,046	5.00	79.36	2,578	532	165	2,743	697	6
18	.26	18	.26	7.47	241	223	82	323	305	7
....	....	55	.15	7.57	726	726	294	1,020	1,020	8
294	1.00	519	1.76	62.68	828	534	356	1,184	890	9
602	2.00	668	2.22	52.47	1,273	671	162	1,435	833	10
800	2.00	1,060	2.65	69.92	1,516	716	187	1,703	903	11
96	.25	96	.25	16.24	591	495	....	591	495	12
....	....	3,000	2.99	58.90	5,093	5,093	245	5,338	5,338	13
2,000	2.39	2,196	2.62	60.98	3,601	1,601	325	3,926	1,926	14
....	....	1,050	1.34	33.55	3,130	3,130	340	3,470	3,470	15
695	.53	2,186	1.67	65.43	3,341	2,646	525	3,866	3,171	16
2,266	1.30	2,381	1.37	66.58	3,576	1,310	[b]....	3,576	1,310	17
10,558	5.00	11,847	5.61	67.27	17,611	7,053	....	17,611	7,053	18
3,558	[c]....	4,121	[c]...	65.28	6,313	2,755	383	6,696	3,138	19
1,904	2.00	3,488	3.66	38.60	9,036	7,132	273	9,309	7,405	20
4,050	[c]....	5,844	[c]...	68.10	8,581	4,531	887	9,468	5,418	21
7,252	5.00	22,014	15.18	87.26	25,228	17,976	665	25,893	18,641	22
900	.28	2,430	.75	68.41	3,552	2,652	....	3,552	2,652	23
....	....	1,309	.71	64.26	2,037	2,037	....	2,037	2,037	24
612	.23	1,679	.64	49.05	3,423	2,811	....	3,423	2,811	25
1,977	.37	4,488	.84	57.10	7,860	5,883	....	7,860	5,883	26
7,302	5.00	7,342	5.03	68.25	10,757	3,455	975	11,732	4,430	27
4,431	.78	6,376	1.12	56.20	11,345	6,914	....	11,345	6,914	28
2,049	.48	7,228	1.69	56.62	12,766	10,717	....	12,766	10,717	29
2,889	.59	5,546	1.13	53.21	10,422	7,533	....	10,422	7,533	30
....	....	7,973	[bb]....	46.78	17,043	17,043	....	17,043	17,043	31
3,784	.29	9,172	.71	47.64	19,252	15,468	....	19,252	15,468	32
10,710	.41	42,548	1.63	64.82	65,643	54,933	....	65,643	54,933	33
35,563	2.00	47,049	2.65	73.11	64 353	28,790	4,536	68,889	33,326	34

[aa] Not obtainable; cost not reported.

[bb] Not obtainable; total investment exclusive of land not reported.

TABLE VII. WATER WORKS: RESULTS OF OPERATION —PRIVATE AND MUNICIPAL PLANTS.

Plant number.	Ownership.	Report for year ending	QUANTITY OF WATER CONSUMED.				
			By Private Users.			By municipality (gallons).	Total (gallons).
			Meter service (gallons).	Contract (unmetered) service (gallons).	Total (gallons).		
1	Private	Dec. 1, 1897	.....	2,400,000	2,400,000	100,000	2,500,000
2	Private	June 30, 1897	.....	2,000,000	2,000,000	1,500,000	3,500,000
3	Private	Jan. 1, 1897	.....	6,500,000	6,500,000	2,500 000	9,000,000
4	Private	.....	.....	9,500,000	9,500,000	1,600,000	11,100,000
5	Private	May 18, 1897	7,000,000	16,000,000	23,000,000	1,000,000	24,000,000
6	Private	Jan. 31, 1898	2,870,000	19,000,000	21,870,000	5,000,000	26,870,000
7	Private	April 1, 1898	.....	30,000,000	30,000,000	2,000,000	32 000,000
8	Private	Feb. 28, 1899	1,500,000	30,000,000	31,500,000	5,000,000	36,500,000
9	Private	Nov. 30, 1897	500,000	38,000,000	38,500,000	1,000,000	39,500,000
10	Private	June 30, 1897	1,500,000	40,000,000	41,500,000	2,000,000	43,500,000
11	Private	Jan. 1, 1898	.....	40,000,000	40,000,000	5,000,000	45,000,000
12	Municipal	Mar. 31, 1898	.....	55,000,000	55,000,000	2,000,000	57,000,000
13	Private	Dec. 31, 1897	13,446,109	37,053,891	50,500,000	9,500,000	60,000,000
14	Private	July 31, 1897	7,560,000	43,000,000	50,560,000	12,000,000	62,560,000
15	Private	Oct. 1, 1897	2,500,000	34,000,000	36,500,000	36,500,000	73,000,000
16	Private	Oct. 1, 1897	10,000,000	65,000,000	75,000,000	6,000,000	81,000,000
17	Private	Dec. 31, 1897	16,210,141	55,000,000	71,210,141	20,000,000	91,210,141
18	Municipal	Oct. 31, 1897	45,000,000	50,000,000	95,000,000	10,000,000	105,000,000
19	Private	Dec. 31, 1897	40,558,515	56,811,932	97,370,447	11,497,000	108,867,447
20	Private	Dec. 31, 1896	2,000,000	132,000,000	134,000,000	1,000,000	135,000,000
21	Private	Dec. 31, 1897	30,281,710	69,000,000	99,281,710	51,000,000	150,281,710
22	Private	Jan. 1, 1898	14,666,000	73,000,000	87,666,000	67,834,000	155,500,000
23	Municipal	May 1, 1898	.....	134,000,000	134,000,000	40,300,000	174,300,000
24	Municipal	Nov. 1, 1897	50,000,000	128,000,000	178,000,000	12,000,000	190,000,000
25	Municipal	Jan. 1, 1898	98,069,600	92,950,000	191,019,600	11,500,000	202,519,600
26	Municipal	Dec. 31, 1898	32,986,000	260,000,000	292,986,000	10,950,000	303,936,000
27	Private	Feb. 28, 1897	32,497,139	360,000,000	392,497,139	1,500,000	393,997,139
28	Municipal	Sept. 1, 1897	164,171,635	281,098,153	445,269,788	25,000,000	470,269,788
29	Municipal	Mar. 31, 1898	130,260,000	481,006,550	611,266,550	25,500,000	636,766,550
30	Municipal	Mar. 31, 1897	39,163,358	609,836,642	649,000,000	22,000,000	671,000,000
31	Municipal	Dec. 31, 1897	64,500,000	146,000,000	210,500,000	519,500,000	730,000,000
32	Municipal	Nov. 30, 1898	270,053,610	591,192,700	861,246,310	41,682,021	902,928,331
33	Municipal	Mar. 1, 1898	237,000,000	2,000,000,000	2,237,000,000	1,064,820,295	3,301,820,295
34	Private	Nov. 30, 1897	313,599,237	5,526,000,000	5,839,599,237	75,000,000	5,914,599,237

TABLE VIII. WATER WORKS: DISTRIBUTION OF COST OF PRODUCTION—MUNICIPAL PLANTS.

Plant number.	Total cost of production including depreciation.	Income from private users.	Result to the City.	
			Cost.	Profit.
12	$591	$5,726	.....	$5,135
18	17,611	11,228	$6,383	.....
23	3,552	9,582	.....	6,030
24	2,037	14,182	.....	12,145
25	3,423	20,002	.....	16,579
26	7,860	29,471	.....	21,611
28	11,345	42,583	.....	31,238
29	12,766	41,788	.....	29,022
30	10,422	51,165	.....	40,743
31	17,043	54,484	.....	37,441
32	19,252	103,302	.....	84,050
33	65,643	215,190	.....	149,547

TABLE IX. WATER WORKS: CERTAIN ADDITIONAL ELEMENTS THEORETICALLY ENTERING INTO THE COST IN MUNICIPALLY OWNED PLANTS.

Plant number.	Estimated rental value of the quarters occupied rent free.	Estimated taxes.	Interest on total investment.	Total additional cost.	Additional cost per 1,000 gallons.
12	$60	$320	$1,629	$2,009	$1.0045
18	50	200	8,757	9,007	.9007
23	100	3,273	13,156	16,529	.4101
24	50	1,330	8,349	9,729	.8108
25	200	3,313	11,212	14,725	1.2804
26	744	6,034	21,925	28,703	2.6213
28	450	6,832	25,189	32,471	1.2988
29	....	5,313	20,446	25,759	1.0102
30	654	6,000	27,174	33,828	1.5376
31	800	10,500	25,240	36,540	.0703
32	2,900	17,575	52,954	73,429	1.7616
33	500	18,885	111,922	131,307	.1233

TABLE X. WATER WORKS: PROFIT AND LOSS—PRIVATE PLANTS.

Plant number.	Report for year ending	GROSS INCOME.							Total cost of production including depreciation and taxes.	NET PROFIT.			Net loss.
		From public service.		From commercial service.		From all other sources.		Total.		Amount.	Per cent. of total gross income.	Per cent. of total investment.	
		Amount.	Per cent. of total gross income.	Amount.	Per cent. of total gross income.	Amount.	Per cent. of total gross income.						
1	Dec. 1, 1897	$3	0.43	$700	99.57	.....	.....	$703	$541	$162	23.04	6.48	.....
2	June 30, 1897	2,590	72.14	1,000	27.86	.....	.....	3,590	3,380	210	5.85	.26	.....
3	Jan. 1, 1897	440	18.03	2,000	81.97	.....	.....	2,440	1,760	680	27.87	3.40	.....
4	[a].....	640	29.91	1,500	70.09	.....	.....	2,140	436	1,704	79.63	5.88	.....
5	May 18, 1897	1,050	11.71	7,918	88.29	.....	.....	8,968	3,805	5,163	57.57	7.47	.....
6	Jan. 31, 1898	600	13.19	3,933	86.50	$14	0.31	4,547	2,743	1,804	39.67	4.02	.....
7	April 1, 1898	35	1.93	1,778	98.07	.....	.....	1,813	324	1,489	82.13	20.90	.....
8	Feb. 28, 1899	1,350	18.59	5,911	81.41	.....	.....	7,261	1,020	6,241	85.95	11.16	.....
9	Nov. 30, 1897	363	10.17	3,205	89.83	.....	.....	3,568	1,185	2,383	66.79	7.90	.....
10	June 30, 1897	470	11.81	3,509	88.19	.....	.....	3,979	1,435	2,544	63.94	7.97	.....
11	Jan. 1, 1898	945	21.26	3,500	78.74	.....	.....	4,445	1,703	2,742	61.69	5.48	.....
13	Dec. 31, 1897	840	6.99	11,176	93.01	.....	.....	12,016	5,338	6,678	55.58	6.35	.....
14	July 31, 1897	895	11.36	6,981	88.64	.....	.....	7,876	3,925	3,951	50.17	4.33	.....
15	Oct. 1, 1897	1,075	14.00	6,401	83.33	205	2.67	7,681	3,470	4,211	54.82	5.26	.....
16	Oct. 1, 1897	2,285	14.73	13,030	83.99	198	1.28	15,513	3,866	11,647	75.08	5.13	.....
17	Dec. 31, 1897	2,523	26.40	6,978	73.01	56	.59	9,557	3,576	5,981	62.58	3.29	.....
19	Dec. 31, 1897	3,596	25.63	10,435	74.37	.....	.....	14,031	6,696	7,335	52.28	2.73	.....
20	Dec. 31, 1896	1,200	8.88	12,110	89.60	206	1.52	13,516	9,309	4,207	31.13	4.33	.....
21	Dec. 31, 1897	2,098	11.33	16,037	86.61	382	2.06	18,517	9,468	9,049	48.87	5.03	.....
22	Jan. 1, 1898	2,000	11.34	13,591	77.05	2,048	11.61	17,639	25,893	.....	.....	.....	$8,254
27	Feb. 28, 1897	1,430	7.64	17,291	92.36	.....	.....	18,721	11,731	6,990	37.34	4.71	.....
34	Nov. 30, 1897	15,000	7.47	185,180	92.28	500	.25	200,680	68,889	131,791	65.67	6.84	.....

[a] Not reported.

TABLE XI. WATER WORKS: PRICES (private plants) AND COST OF PRODUCTION (municipal plants) OF WATER SERVICE.

Plant number.	Ownership.	Report for year ending	Average price per 1,000 gallons to private users.			Average price (when bought) or cost (when produced) per 1000 gallons to municipality.
			For meter service.	For contract service.	For both meter and contract service.	
1	Private	Dec. 1, 1897	.....	$0.2917	$0.2917	$0.0300
2	Private	June 30, 1897	.....	.5000	.5000	1.7267
3	Private	Jan. 1, 1897	.....	.3077	.3077	.1760
4	Private	[a].....	.....	.1579	.1579	.4000
5	Private	May 18, 1897	$0.1214	.4418	.3443	1.0500
6	Private	Jan. 31, 1898	.1024	.1823	.1718	.1550
7	Private	April 1, 1898	.....	.0593	.0593	.0175
8	Private	Feb. 28, 1899	.1800	.1880	.1877	.2700
9	Private	Nov. 30, 1897	.2500	.0811	.0832	.3630
10	Private	June 30, 1897	.2333	.0790	.0846	.2350
11	Private	Jan. 1, 1898	.....	.0875	.0875	.1890
12	Municipal	Mar. 31, 1898	.....	.1041	.1041	[b].....
13	Private	Dec. 31, 1897	.1859	.2341	.2213	.0884
14	Private	July 31, 1897	.1000	.1448	.1381	.0746
15	Private	Oct. 1, 1897	.1920	.1741	.1754	.0295
16	Private	Oct. 1, 1897	.1944	.1706	.1737	.3808
17	Private	Dec. 31, 1897	.1593	.0799	.0980	.1261
18	Municipal	Oct. 31, 1897	.1333	.1006	.1161	.6383
19	Private	Dec. 31, 1897	.0969	.1145	.1072	.3128
20	Private	Dec. 31, 1896	.1500	.0895	.0904	1.2000
21	Private	Dec. 31, 1897	.1703	.1577	.1615	.0411
22	Private	Jan. 1, 1898	.1125	.1636	.1550	.0295
23	Municipal	May 1, 1898	.....	.0697	.0697	[b].....
24	Municipal	Nov. 1, 1897	.1000	.0708	.0790	[b].....
25	Municipal	Jan. 1, 1898	.0500	.1601	.1035	[b].....
26	Municipal	Dec. 31, 1898	.0739	.0974	.0948	[b].....
27	Private	Feb. 28, 1897	.0997	.0390	.0441	.9533
28	Municipal	Sept. 1, 1897	.0861	.1012	.0956	[b].....
29	Municipal	Mar. 31, 1898	.0855	.0596	.0651	[b].....
30	Municipal	Mar. 31, 1897	.1636	.0719	.0774	[b].....
31	Municipal	Dec. 31, 1897	.1109	.3214	.2569	[b].....
32	Municipal	Nov. 30, 1898	.1330	.1140	.1199	[b].....
33	Municipal	Mar. 1, 1898	.2597	.0738	.0935	[b].....
34	Private	Nov. 30, 1897	.0728	.0294	.0317	.2000

[a] Not reported. [b] Nothing; income from private users exceeds total cost of production.

DESCRIPTIVE ANALYSIS OF THE WATER WORKS TABLES.

Table I states the fuel conditions of these concerns. Only six require fuel. One of them uses wood exclusively. Another consumes bituminous coal and wood. A third burns bituminous coal, wood, and oil. Three utilize bituminous coal exclusively. The bituminous coal cost prices ranging from $2.46 to $4.69 per ton.

Table II gives exhibits concerning the various plants, the distributing equipments, and the apparatus owned. Out of the thirty-four reporting, varying in age from six years to fifty-two years, only three have changed ownership. Of these thirty-four works, but twelve are municipal, twenty-two being private. In the distribution of the water, thirty are of the gravity system, two have reservoirs, and two use tanks. Only one stand-pipe was reported. The greatest storage capacity of any of the works was 2,500,000,000 gallons, and the smallest capacity was 87,000 gallons. Nine of these concerns have a pumping equipment, two of them using water-power for pumping; four, steam power; and three both steam and water-power. Of the mains in use, the largest is three feet in diameter, and the smallest is .75 inch. The length of mains in each plant varies from one mile up to 96.68 miles. There is much other interesting material in the table, descriptive of the several plants.

Table III treats of the investment in the various plants. The construction for storage at the source of supply is one of the largest places of output of funds, in one instance reaching 63.50 per cent. of the total investment. Another place for a large expenditure of money is the mains. The mains of No. 17 took 75.73 per cent. of the total investment. The other expenditures are for land, conduits, buildings, pumping equipments, distributing reservoirs, stand-pipes, tanks, filters and filtration beds, meters, hydrants, teams, tools, and other accessories. The total investments in each plant range from $2,500 to $1,928,134.

Table IV reveals the source of funds used in the investment. In municipal plants the total investments of the plants owned by

cities, boroughs and towns range from $40,737 to $2,798,061. These amounts are derived, in a few instances, to a small extent, from taxation, also to quite a part from transfers from funds on hand and for the most part from the issuing of bonds. The dates of the issue and of the maturity of the bonds are given. The rates per cent. of interest on the bonds ranges from 3.50 to 7, inclusive. In no instance was less than par realized from the sale of the bonds, and in one case $107.50 was the amount per $100 par realized.

Table V accounts for the gross income of all the concerns. Seventeen, or just one-half of them, receive their total gross income from the sale of water. The other fourteen receive from 94.22 to 99.75 per cent. of their total gross income from the sale of water. Their other sources of income, to complete the 100 per cent., are rents and sales of meters and miscellaneous sources. The total gross incomes are from $703 to $215,190 per annum.

Table VI computes the cost of production. The cost is reckoned by the year, and, as in the case of the electric and gas table, here, too, the year reported upon is the fiscal year of each plant nearest the calender year from January 1, 1897, to January 1, 1898. Under general expenses, the most important item is salaries of officers, superintendents, clerks, etc., which run from $11 to $11,120 per year at each concern. The general expenses, also include office supplies and expenses, legal expenses and damages, licenses, royalties, and miscellaneous, being from 2.94 to 76.99 per cent. of the total cost of production. The wages for the various works vary from $20 to $2,315, each, per year, being between .37 and 62.24 per cent. of the total cost of production. The supplies cost from .04 to 41.04 per cent. of the total expense of production, and include fuel, pumping station supplies, filtration and miscellaneous supplies. The rebates and worthless bills figure from $10 to $400, each establishment, per annum. For maintenance, the charges are on storage and construction at source of supply, on buildings, on pumping equipment, on distributing reservoir, standpipes and tanks, on filters and filtration beds, on mains and other distributing equipment, etc., and these

amounts expended for maintenance are from .03 to 14.58 per cent. of the total investment, exclusive of land. The estimated depreciation of the various plants is from $18 to $35,563 per year, or from .23 to 5 per cent. of the total investment, exclusive of land. The total maintenance ranges from $18 to $47,049, inclusive, per plant, per year; which is from .15 to 19.58 per cent. of the total investment, exclusive of land, and from 7.47 to 92.16 per cent. of the total cost of production. The taxes vary between $31 and $4,536, inclusive. The total cost of production and taxes, including estimated depreciation, was from $323 to $68,889, and excluding estimated depreciation was from $305 to $54,933.

Table VII displays the results of the operation of the several plants. It does this by showing the quantity of water consumed at the various works. There are two classes of users, — private and municipal. The proportion used by each varies. In one instance the municipality takes 1/261 of the water consumed, and in another more than 2/3. In the remaining cases the parts taken by the municipal party are between these two proportions. The total number of gallons consumed in a year by both is from 2,500,000 to 5,914,599,237.

Table VIII places the distribution of the cost of production in municipal plants. In each of them the income, except in No. 18, from private users, pays the cost of production, so that the municipality has its water without expense and nets the municipalities profits from $5,135 to $149,547 each, per annum. No. 18, according to the showing, has, in addition to its income from private users, to pay $6,383 for its own water, but by Table VI one finds it has charged off to "estimated depreciation" $10,558. The profits of the others, above mentioned, are shown, although large sums have been charged in each instance to "estimated depreciation."

Table IX enumerates and estimates certain additional elements theoretically entering into the cost in municipally owned plants. These factors are estimated rental, value of the quarters occupied, rent free, estimated taxes, and interest on total investment. These show a theoretical total additional cost of from

$2,009 to $131,307 each, or an additional cost per 1,000 gallons of water from $0.0703 to $2.6213, each.

Table X reckons the profit and loss of the twenty-two private companies. The annual gross income, which comes from public service, commercial service, and other sources enumerated in Table V, amounts to sums between $703 and $200,680, each, inclusive. The total cost of production, including " estimated depreciation " and taxes, is between $324 and $68,889, each, inclusive; leaving net profits for every concern, except No. 22, of from $162 to $131,791, although large sums were charged out in each case by " estimated depreciation " in Table VI. These profits are from 5.85 to 85.95 per cent. of the total gross income and from .26 to 20.90 per cent. of the total investment. No. 22 figures a net loss of $8,254, but here also it seems only fair to note in passing that, in Table VI $7,252 were charged off to "estimated depreciation," and an unusual sum was expended by this plant during this particular year in " construction at the source of supply " and in putting in mains, viz.: $14,762.

Table XI presents the prices, of private plants, and the cost of production of municipal plants, of the water service. It figures the average price per 1,000 gallons to private users, and the average price (when bought) or cost (when produced) per 1,000 gallons to each municipality. In some private plants the private users have advantage over the municipalities, and in others the vantage is the other way. But in municipal works, as was observed from Table VIII, No. 18 excepted, the private users pay all costs and expenses, and the towns, boroughs and cities secure their water supply without cost, and, indeed, make a profit from the private users.

Public attention has been called to the scarcity of water in many localities of the State during the latter part of the current year, the supply, in many instances, having become almost entirely exhausted. The fact that such a condition obtains has resulted in the setting forth of the argument by some economists that municipal ownership of public utilities would be of benefit to public communities. The contention is made that should a

town, city, or borough own its own water plant a liberal and far-reaching policy would be brought about whereby an abundant supply could always be depended upon, and the needs of a community, constantly increasing in population, would be more liberally and consistently considered. On the other hand it is contended that it would be more difficult to secure a majority vote in a town, city, or borough meeting in order to secure the adoption of the requisite measures for the acquisition of additional territory for the required purpose of an increased water supply than to obtain the authority for the same purpose from a board of directors of a private corporation. It should be stated, however, that among the localities in the State most affected by an insufficient supply of water there are some which are controlled by corporations and others by municipalities.

Part II

Condition of Manufactures

1 PERSONS EMPLOYED

2 DISTRIBUTION OF WAGES

3 AVERAGES

4 ANALYSIS

CONDITION OF MANUFACTURES.

This portion of the report is designed to bring into comparison the number of persons on the pay-rolls of the various identical establishments represented in the tabulation at the specified date of July 1st in each of the years 1896, 1897, 1898, and 1899, and also to show by similar comparison the amounts disbursed as wages (exclusive of salaries) by the same establishments during the periods ending July 1st of the same years.

As will be seen by reference to the "recapitulation" to be found on page 124 of the report, there are 668 establishments represented in the tables, subdivided and classified under several heads or industries; this classification having been made with a view to showing, as closely as possible, the kind of goods manufactured by them. It must be understood, however, that while the division as to "Industry product" has been carefully made, yet there are many establishments classified under one head which might very properly be classed under several, such, for example, as the industry placed in the tables as "Brass and Brass Goods." While few of the number thus classified produce articles wholly of brass, yet the larger portion of their product is made up wholly or in part of that metal. Again, there are some which produce articles the major component parts of which are of iron, yet in the course of manufacture other metals to a greater or less extent are used, but all have been classified so as to show them as nearly as possible under the heading the designation of which will give the reader a clear understanding as to the class of goods to which the tables refer.

Moreover, it might be stated that the industry referred to in the tables as "Machine Shops" does not mean, in the concrete, manufacturers of machinery only, but includes those establish-

ments manufacturing articles which enter into and eventually become a part of a machine of some description, and, furthermore, the classification also includes those concerns which make and also repair "special" machines and machinery.

It would be difficult to make a division "by industries" which would convey to the reader a more clear and comprehensive knowledge of the kind of goods referred to in the tabulation without in some measure disclosing the identity of the establishments furnishing the Bureau with the information contained in the report; and as all such information is secured by the representatives of the department under and with the distinct understanding that the name or location of the firm, corporation, or individual supplying the desired data is not to be disclosed, it can plainly be seen that more details as regards "kind of goods made" would tend toward a further disclosure of identity than the pledge given by the Bureau comprehends.

As before stated, there are 668 different establishments represented. The analysis by industries which follows the tables will give the reader a clear idea as to the increase or decrease in the number employed and the amount paid in wages during the year ending July 1, 1899, in comparison with the figures for the same establishments for the same period of 1896, and will also show by comparison the average increase or decrease in 1899 over or from the average figures for the four years covered by the investigation.

It must be understood, however, in making comparisons, that while in most cases the number employed on July 1st in any given year may be taken as a true average for the year referred to, yet, as will appear, there are instances where the number employed on July 1st of the latter year to which the data refer may be less than for the corresponding date of the former period, while the amount paid in wages may be larger, thus showing an apparent discrepancy. This can be explained when it is understood that the figures concerning the number employed are taken as at a specified date, while the amount given as having been disbursed as wages is taken "from and to" a specified date. Thus

it can be seen that by far the best and truest barometer by which to judge improvement or depression in industrial conditions is the wage account, for it is a true principle of economics that upon the amount distributed as the reward of labor depends the world's prosperity.

Examination of the table above referred to will disclose the interesting fact that there is a visible improvement in the manufacturing industries of the State, and not only has the number of wage-earners on the pay-rolls of the same establishments at the dates hereinbefore mentioned largely increased, but the distribution of wages has also, although in a lesser degree, become greater. In this connection it should be made clear that while the increase per cent. of the number employed is greater than the per cent. of increase shown in the amount paid in wages, it does not necessarily follow that the rate of wages has decreased, for, as must be seen, the period covered by the investigation in respect of the wage account covers the entire year, while the inquiry concerning the number employed applies to the specified date of July 1st in each year, thus it is rendered possible that the percentage concerning one point might be in excess of that covering the other, and it is perfectly fair to assume, when the figures given in the table are considered, that up to and probably just preceding the date, at which the data for the number employed are given, a lesser number of employes were on many of the pay-rolls of the establishments considered than had been the average number employed for a considerable period antecedent thereto, and that the effect of an increased number of employes had not been materially felt in so far as increased disbursements for wages are concerned. Therefore, it appears to be also safe to assume that the very apparent period of industrial prosperity had but just begun at the date of the close of the investigation covered by the report, and it is equally fair to assume from the information given by many manufacturers that the time required to furnish the department with the desired information could illy be spared from the requirements of their business caused by an overwhelming demand for the product manufactured by them.

In summarizing the data contained in the table, it will be seen that the number of employes on the pay-rolls of the several identical establishments on July 1, 1896, was 85,395; the same establishments at the same date in 1899 employing 97,922, an increase in the number employed on the latter date over the former of 14.7 per cent. The average number on the pay-rolls of these establishments for the years 1896, 1897, 1898, and 1899 was 89,453, showing an increase in the number employed in 1899 over the average for four years of 9.5 per cent.

The table also shows that the amount disbursed as wages by these establishments during the year ending July 1, 1896, was $38,577,737.30, and that during the year ending at the same date in 1899 the same establishments paid out $41,132,592.56, being an increase in disbursements in 1899 over the amount distributed in 1896 of 6.6 per cent.; the average amount paid in wages for the four years was $38,674,578.29, thus showing an increase in 1899 over the average for 1896, 1897, 1898, and 1899 of 6.4 per cent.

INDUSTRY: BRASS AND BRASS GOODS.

Number of establishment.	Persons employed July 1.				Amount paid in wages during year ending July 1.				Per cent. number employed, 1896–1899.		Per cent. amount paid in wages, 1896–1899.	
	1896	1897	1898	1899	1896	1897	1898	1899	Increase.	Decrease.	Increase.	Decrease.
1	366	427	497	623	$180,500.00	$180,500.00	$221,332.39	$264,151.00	70.2	.....	46.3	.....
2	700	675	800	925	324,000.00	316,557.00	385,000.00	395,000.00	32.1	.....	21.9	.....
3	54	60	50	70	27,931.83	21,000.00	26,899.54	28,766.55	27.8	.....	2.9	.....
4	155	157	164	149	84,904.45	86,734.88	95,755.75	94,709.42	.....	3.9	11.5	.....
5	205	234	207	251	100,000.00	100,909.00	104,080.00	107,256.00	22.4	.....	7.3	.....
6	317	271	247	400	143,564.65	117,998.00	113,704.00	130,000.00	26.2	.....	.....	9.4
7	83	109	112	103	28,820.35	34,251.75	36,452.80	35,686.64	24.1	.....	23.8	.....
8	725	761	1,005	1,187	398,219.35	376,142.30	521,287.60	585,466.09	63.7	.....	47.0	.....
9	8	8	6	4	4,328.00	3,487.50	2,973.00	2,496.00	.....	50.0	.....	42.3
10	6	9	13	12	3,473.72	4,068.27	4,856.89	6,195.31	100.0	.....	78.3	.....
11	14	16	15	18	7,000.00	6,567.25	6,800.00	7,000.00	28.4	.....	.....	.....
12	208	220	226	288	118,614.91	111,971.41	117,639.00	128,729.30	38.5	.....	8.5	.....
13	31	26	25	20	12,900.00	11,368.00	10,844.00	8,845.00	.....	35.5	.....	31.4
14	15	13	14	14	10,335.60	4,067.33	5,130.26	5,353.33	.....	6.7	.....	48.2
15	16	12	13	15	11,201.41	10,000.00	10,343.00	8,215.38	.....	6.3	.....	26.7
16	96	86	76	83	26,216.29	46,268.70	44,188.50	35,000.00	.....	13.5	33.5	.....
17	8	8	8	8	3,100.00	3,100.00	3,100.00	3,200.00	.....	.....	3.2	.....
18	5	6	5	7	3,000.00	3,000.00	2,600.00	3,966.00	40.0	.....	32.2	.....
19	594	533	559	686	275,021.70	249,195.13	129,329.77	296,825.28	15.5	.....	7.9	.....
20	307	268	250	368	167,667.00	129,254.00	143,787.00	151,297.00	19.9	.....	.....	9.8
21	80	73	82	85	38,294.15	37,727.40	42,218.76	46,061.94	6.2	.....	20.3	.....
22	158	118	124	132	51,678.85	57,690.55	64,157.07	56,329.48	.....	16.5	9.0	.....
23	168	188	200	270	70,774.96	78,572.05	81,692.68	107,845.65	60.7	.....	52.4	.....
24	4	3	3	4	2,460.00	2,260.00	2,310.00	2,550.00	.....	.....	3.7	.....
25	236	233	240	242	130,367.25	115,574.67	135,474.09	135,521.32	2.5	.....	3.9	.....
26	10	11	7	13	4,600.00	6,000.00	3,000.00	1,600.00	30.0	.....	.....	65.2
27	358	299	226	297	188,166.13	184,508.63	141,522.00	145,800.46	.....	17.0	.....	22.5
28	575	545	674	643	246,582.92	244,672.75	261,714.30	269,224.75	11.8	.....	9.2	.....
29	11	10	9	16	3,758.80	3,847.11	3,809.51	4,295.00	45.5	.....	14.3	.....
30	1,487	1,461	1,870	1,873	971,384.62	742,924.97	905,165.72	947,800.11	26.0	.....	.....	2.4
31	35	50	40	40	17,924.00	19,000.00	17,500.00	17,000.00	14.3	.....	.....	5.2
32	50	50	56	58	22,095.32	24,000.00	24,900.00	49,000.00	16.0	.....	121.8	.....
33	15	15	13	16	10,000.00	9,000.00	5,674.00	7,840.00	6.7	.....	.....	21.6

INDUSTRY: BRASS AND BRASS GOODS — *Concluded.*

Number of establishment.	Persons employed July 1.				Amount paid in wages during year ending July 1.				Per cent. number employed, 1896–1899.		Per cent. amount paid in wages, 1896–1899.	
	1896	1897	1898	1899	1896	1897	1898	1899	Increase.	Decrease.	Increase.	Decrease.
34	5	4	4	3	$3,380.00	$1,680.00	$1,680.00	$1,600.00	.....	40.0	.....	52.7
35	200	211	220	210	108,840.51	105,700.00	114,705.61	121,570.77	5.0	.....	11.7	.....
36	170	169	190	196	94,724.72	69,964.64	88,492.72	98,245.88	15.3	.....	3.7	.....
37	590	600	653	729	274,109.80	300,500.25	351,011.18	372,830.85	23.6	.....	36.0	.....
38	5	5	20	14	2,100.00	2,600.00	5,709.37	5,326.14	180.0	.....	153.6	.....
39	90	98	101	118	47,617.00	57,170.00	50,384.50	62,000.00	31.1	.....	30.2	.....
40	*60	321	450	530	*20,174.00	172,615.00	210,352.02	253,000.00	783.3	.....	1154.1	.....
41	108	93	85	125	50,745.50	51,189.43	48,636.62	49,296.19	15.7	.....	.....	2.9
42	450	442	496	525	248,791.20	230,065.55	282,698.35	309,865.53	16.7	.....	20.5	.....
43	886	954	1,272	1,152	391,000.00	248,462.89	576,763.00	600,000.00	30.0	.....	53.5	.....
44	43	39	25	62	14,058.15	16,534.00	16,185.00	15,872.00	44.2	.....	12.9	.....
45	77	83	84	99	53,818.00	60,985.59	62,129.00	58,804.83	28.6	.....	9.3	.....
46	362	348	450	488	210,592.95	138,893.56	236,236.30	240,782.13	34.8	.....	14.3	.....
47	10	13	15	15	7,000.00	4,100.00	6,000.00	6,500.00	50.0	.....	.....	7.1
48	210	200	200	200	91,260.00	123,000.00	96,617.98	90,120.60	.....	4.8	.....	1.2
49	20	30	34	45	8,000.00	15,000.00	16,779.00	20,800.00	125.0	.....	160.0	.....
50	54	44	27	32	22,000.00	17,000.00	15,373.46	18,801.95	.....	40.7	.....	14.5
51	142	150	125	125	48,200.00	50,000.00	22,000.00	19,000.00	.....	12.0	.....	60.6
52	650	612	800	915	443,932.13	377,043.71	429,290.51	458,360.07	40.8	....	3.3	.....
53	80	100	135	145	45,600.00	33,556.18	40,912.00	50,566.00	81.3	.....	10.9	.....
54	17	1	21	31	9,255.00	10,000.00	12,540.00	14,409.00	82.4	.....	55.7	.....
55	30	30	40	60	14,000.00	14,300.00	15,000.00	21,000.00	100.0	.....	50.0	.....
56	1,144	1,052	1,134	1,287	494,650.75	483,183.97	569,507.09	626,741.16	12.5	.....	26.7	.....
57	70	70	79	99	28,000.00	25,000.00	33,000.00	38,960.00	41.4	.....	39.1	.....
58	25	23	24	28	9,103.92	8,750.00	9,961.13	9,800.00	12.0	.....	7.6	.....
59	22	7	14	18	12,012.96	4,525.00	1,471.33	4,456.00	.....	18.2	.....	62.9
60	16	17	17	25	7,592.00	7,277.00	10,742.83	7,891.18	56.3	.....	3.9	.....
61	221	263	375	383	115,947.00	87,643.00	137,936.00	138,985.00	73.3	.....	19.9	.....
62	105	99	126	120	32,646.05	30,814.77	39,161.84	39,755.34	14.3	.....	21.8	.....
63	892	716	834	819	467,706.69	388,522.53	468,217.86	453,819.26	.....	8.2	.....	3.0
64	10	8	14	10	10,000.00	8,500.00	6,630.00	6,375.00	.....	.....	.....	36.3
Total,	13,864	13,773	15,900	17,528	$ 7,075,744.59	$ 6,487,882.72	$ 7,651,366.33	$ 8,304,561.89	26.4	.....	17.4	.....

* Temporarily closed.

INDUSTRY: CARRIAGES AND CARRIAGE PARTS.

Number of establishment.	Persons employed July 1.				Amount paid in wages during year ending July 1.				Per cent. number employed, 1896–1899.		Per cent. amount paid in wages, 1896–1899.	
	1896	1897	1898	1899	1896	1897	1898	1899	Increase.	Decrease.	Increase.	Decrease.
65	26	25	25	25	$16,000.00	$11,000.00	$15,000.00	$15,000.00	.....	6.1	.....	3.8
66	6	7	6	7	5,000.00	4,500.00	4,380.00	4,680.00	16.7	.....	.....	6.4
67	15	15	15	15	14,000.00	14,000.00	14,200.00	13,700.00	.....	.....	.....	2.1
68	185	185	200	200	125,000.00	125,000.00	128,000.00	131,682.84	8.1	.....	5.3	.....
69	65	52	66	73	50,000.00	35,000.00	42,000.00	46,200.00	12.3	.....	.....	7.6
70	33	34	55	75	27,000.00	23,200.00	26,500.00	24,000.00	127.3	.....	.....	11.1
71	32	23	20	25	23,849.91	14,284.88	12,900.00	11,000.00	.....	21.9	.....	53.9
72	100	100	100	115	69,375.00	69,317.00	69,400.00	75,000.00	15.0	.....	8.1	.....
73	25	25	20	10	15,000.00	15,000.00	12,500.00	8,000.00	.....	60.0	.....	46.7
74	14	35	40	40	8,937.00	20,000.00	17,350.00	24,000.00	185.7	.....	168.5	.....
75	15	12	11	10	8,500.00	8,325.00	7,449.04	6,756.95	.....	33.3	.....	20.5
76	19	17	15	15	12,000.00	9,100.00	8,000.00	15,000.00	.....	21.1	25.0	.....
77	35	30	28	38	12,000.00	9,500.00	10,000.00	13,500.00	8.6	.....	12.5	.....
78	22	22	22	27	14,400.00	15,470.00	15,610.00	17,160.00	22.7	.....	19.2	.....
79	21	19	20	24	12,882.33	12,500.00	13,600.00	15,000.00	14.3	.....	16.4	.....
Total,	613	601	643	699	$413,944.24	$386,196.88	$396,889.04	$420,679.79	14.0	.....	1.6	.....

INDUSTRY: CORSETS.

Number of establishment.	Persons employed July 1.				Amount paid in wages during year ending July 1.				Per cent. number employed, 1896–1899.		Per cent. amount paid in wages, 1896–1899.	
	1896	1897	1898	1899	1896	1897	1898	1899	Increase.	Decrease.	Increase.	Decrease.
80	55	59	60	63	$18,570.00	$17,340.00	$19,000.00	$18,250.00	14.5	.....	.....	1.7
81	20	10	10	13	8,000.00	2,500.00	2,500.00	2,753.00	.....	35.0	.....	65.6
82	225	250	250	275	80,000.00	85,000.00	85,000.00	100,000.00	22.2	.....	25.0	.....
83	200	275	300	300	64,000.00	60,000.00	66,000.00	66,000.00	50.0	.....	3.1	.....
84	821	896	934	965	267,047.00	296,145.00	332,194.00	367,285.00	17.5	.....	37.5	.....
85	691	732	772	828	205,946.00	215,056.43	241,597.00	253,460.00	19.8	.....	23.1	.....
86	80	75	91	75	22,275.00	20,885.00	26,234.00	18,400.00	.....	6.3	.....	17.4
87	1400	1400	1400	1400	520,000.00	456,000.00	510,180.00	500,000.00	.....	.....	.....	3.8
88	583	585	571	561	184,788.44	176,269.30	194,145.80	160,731.26	.....	3.8	.....	13.0
89	350	350	350	360	80,000.00	80,000.00	75,000.00	85,000.00	2.9	.....	6.2	.....
Total,	4425	4632	4738	4840	$ 1,450,626.44	$ 1,409,195.73	$ 1,551,850.80	$ 1,571,879.26	9.4	.....	8.4	.....

INDUSTRY: COTTON GOODS.

Number of establishment.	Persons employed July 1.				Amount paid in wages during year ending July 1.				Per cent. number employed, 1896–1899.		Per cent. amount paid in wages, 1896–1899.	
	1896	1897	1898	1899	1896	1897	1898	1899	Increase.	Decrease.	Increase.	Decrease.
90	12	12	12	12	$5,500.00	$4,684.00	$6,000.00	$5,700.00	.....	.....	3.6	.....
91	1525	1442	1525	1473	582,238.51	460,679 00	524,000.00	500,936.07	.....	3.4	.....	14.●
92	36	33	40	38	10,368.00	12,500.00	11,250.00	13,000.00	5.6	.....	25.4	.....
93	15	20	25	25	5,000.00	5,150.00	6,240.00	7,500.00	66.7	.....	50.0	.....
94	18	19	20	23	7,714.00	6,934.00	7,525.00	8,712.00	27.8	.....	12.9	.....
95	152	159	138	182	52,675.86	47,123.27	50,705.04	61,637.09	19.1	.....	17.0	.....
96	15	6	8	8	2,750.00	1,000.00	1,500.00	1,500.00	.....	46.7	.... .	45.5
97	34	34	37	39	7,301.08	7,071.12	11,000.00	8,254.75	14.7	.....	13.1	.....
98	31	21	34	38	7,722.07	7,141.01	9,741.73	9,627.68	22.6	.....	24.7	.....
99	34	17	32	33	6,107.00	4,080.00	8,700 00	9,120.00	.....	2.9	49.3	.....
100	62	56	61	65	15,232.00	12,011.00	14,000.00	14,000.00	4.8	.....	.....	8.1
101	6	6	6	7	1,750.00	1,825.00	1,800.00	2,100.00	16.7	.....	20.0	.....
102	88	84	103	85	25,197.00	30,000.00	27,221.82	24,306.00	.....	3.4	.....	3.5
103	350	350	350	330	125,000.00	103,828 60	115,121.72	119,593.47	.....	5.7	.....	4.3
104	8	7	9	7	1,599.50	1,494.50	1,675.00	1,890.39	.....	12.5	18.2	.. ...
105	736	829	836	925	239,498.00	208,121.59	261,605.37	290,000.00	25.7	.....	21.1	.....
106	160	160	160	160	45,000.00	45,000.00	50,000.00	50,000.00	.....	.....	11.1	.....
107	26	18	28	40	7,640.69	6,579.53	7,824.00	14,728.30	53.8	.....	92.8	.....
108	20	42	27	18	11,000.00	15,450.00	9,480.00	10,400.00	.....	10.0	.....	5.5
109	195	205	225	240	79,575.00	77,551.00	8 ,000.00	96,600.00	23.1	.....	21.4	.....
110	42	27	32	34	12,000.00	10,000.00	10,000.00	9,802.41	.....	19.0	.....	18.3
111	10	10	7	10	11,400.00	12,000.00	3,344.96	3,600.00	.....	.....	.....	68.4
112	157	121	150	181	55,720.50	46,741.00	42,000.00	56,000.00	15.3	.....	.5	.....
113	196	250	300	300	65,893.00	63,000.00	100,000.00	83,000.00	53.1	.....	26.0	.....
114	140	120	150	132	38,000.00	41,600.00	44,002.03	42,709.94	.....	5.7	12.4	.....
115	136	115	135	96	82,000.00	57,500.00	65,000.00	57,000.00	.....	29.4	.....	30.5
116	140	185	180	237	47,000.00	45,000.00	62,000.00	70,000.00	69.3	.....	48.9	.....
117	32	40	50	51	16,237.62	7,219.66	11,925.73	15,922 42	59.4	.....	.....	1.9
Total,	4376	4388	4680	4789	$ 1,567,119.83	$ 1,341,284.28	$ 1,551,662.40	$ 1,587,640.52	9.4	.....	1.3	.....

INDUSTRY: COTTON MILLS.

Number of establishment.	Persons employed July 1.				Amount paid in wages during year ending July 1.				Per cent. number employed, 1896–1899.		Per cent. amount paid in wages, 1896–1899.	
	1896	1897	1898	1899	1896	1897	1898	1899	Increase.	Decrease.	Increase.	Decrease.
118	200	210	225	400	$57,000.00	$59,850.00	$65,000.00	$102,000.00	100.1	.....	78.9	.....
119	259	267	302	367	114,037.19	127,626.53	144,004.02	155,379.10	41.7	.....	36.3	.....
120	700	653	674	627	211,960.81	185,571.00	188,793.43	186,120.36	.....	10.4	.....	12.2
121	234	259	222	236	50,000.00	67,551.64	72,336 85	73,015.05	.9	.....	46.0	.....
122	233	215	205	210	58,844.00	54,355.53	54,248.91	56,048.94	.....	9.9	.....	4.7
123	489	475	486	486	156,000.00	98,000.00	139,604.77	156,057.42	.....	.6	.....	.....
124	480	500	500	504	149,777.80	99,696.50	150,175.12	147,145 37	5.0	.....	.....	1.8
125	138	135	157	143	45,174.00	38,939.22	38,475.97	42,989.23	3.6	.....	.....	4.8
126	725	692	685	725	185,000.00	181,705.85	182,944.26	180,000.00	.....	.....	.....	2.7
127	112	108	99	95	26,600.25	24,800.00	26,317.04	26,400.00	.....	15.2	.....	.8
128	310	298	278	280	109,400.00	111,949.29	115,389.03	106,600.00	.....	9.7	.....	2.6
129	138	142	142	135	42,345.34	41,053.12	41,909.17	39,695.77	.....	2.2	.....	6.3
130	1272	1324	1397	1430	401,016.00	432,117.61	456,210.99	404,902.53	12.4	....	1.0	.....
131	16	16	14	22	5,400.00	5,700.00	5,000.00	7,000.00	37.5	.....	29.6	.....
132	170	168	173	179	55,732.27	51,125.00	55,000.00	54,000.00	5.3	.....	.....	3.1
133	132	133	126	127	42,356.95	40,000.00	43,000.00	41,300.00	.....	3.8	.....	2.5
134	122	125	120	124	42,232.85	39,500.00	42,000.00	40,800.00	1.6	.....	.....	3.4
135	361	515	547	159	164,700.00	146,531.42	167,724.31	113,105.34	.....	56.0	.....	31.3
136	153	150	152	160	42,919.38	36,615.50	52,624.47	42,500.00	4.6	.....	.....	1.0
137	1400	1450	1500	1500	413,729.16	465,000.00	500,000.00	424,318.30	7.1	.....	2.6	.....
138	280	275	274	296	82,642.22	79,727.84	77,671.53	87,004.48	5.7	.....	5.3	.....
139	190	195	189	238	54,726.40	56,742.36	52,256.25	58,104.00	25.3	.....	6.2	.....
140	300	325	325	350	98,755.27	102,479.28	104,325.79	110,000.00	16.7	.....	11.4	.....
Total,	8414	8630	8792	8793	$ 2,610,349.98	$ 2,546,637.69	$ 2,775,011.91	2,654 485.89	4.5	.....	1.7	.....

INDUSTRY: CUTLERY AND TOOLS.

Number of establishment.	Persons employed July 1.				Amount paid in wages during year ending July 1.				Per cent. number employed, 1896–1899.		Per cent. amount paid in wages, 1896–1899.	
	1896	1897	1898	1899	1896	1897	1898	1899	Increase.	Decrease.	Increase.	Decrease.
141	42	46	47	52	$18,393.14	$15,245.49	$18,395.19	$15,442.00	23.8	.....	.....	16.0
142	80	70	80	80	40,000.00	32,000.00	36,000.00	40,000.00	.....	.....	.....	.....
143	38	31	34	39	20,000.00	12,046.60	15,422.08	20,944.32	2.6	.....	4.7	.....
144	150	148	148	160	73,287.37	60,628.73	72,326.39	85,959.65	6.7	.....	17.3	.....
145	50	50	57	69	24,177 63	23,465.77	23,689.62	29,411.28	38.0	.....	21.6	.....
146	78	55	42	79	83,804.19	31,475.60	35,505.95	48,768.36	1.3	.....	.....	41.8
147	60	48	45	45	23,413.56	14,219.43	18,888.19	18,918.22	.....	25.0	.....	19.2
148	95	120	125	80	36,000.00	45,000.00	50,000.00	25,000.00	.....	15.8	.....	30.6
149	30	30	30	30	15,208.81	11,946.18	12,000.00	12,473.92	.....	.....	.....	17.9
150	6	8	9	14	2,442.00	2,914.53	3,241.88	4,355.32	133.3	.....	78.4	.....
151	106	90	121	143	63,226.00	46,032.96	62,580.94	72,447.85	34.9	.....	14.6	.....
152	100	99	108	114	37,194.07	29,324.49	37,702.83	35,429.28	14.0	.....	.....	4.7
153	24	20	20	20	10,314.34	10,044.46	11,680.72	10,410.97	.....	16.7	1.0	.....
154	7	5	4	4	2,482.60	2,100.00	2,000.00	1,200.00	.....	42.9	.....	51.7
155	24	27	37	48	7,200.00	15,300.00	11,250.00	22,011.00	100.0	.....	205.7	.....
156	48	53	56	74	27,450.00	25,498.97	33,363.47	34,912.57	54.2	.....	27.2	.....
157	140	106	156	145	56,432.92	48,255.35	61,151.45	56,268.56	3.6	.....	.....	.3
158	22	18	17	14	8,251.01	16,282.64	5,911.99	6,066.11	.....	36.4	.....	26.5
159	9	9	8	6	2,423.30	2,311.39	2,879.72	1,730.60	.....	33.3	.....	28.6
160	76	69	76	*48	41,000.00	34,000.00	47,500.00	*29,270.00	.....	36.8	.....	28.6
161	14	5	14	14	8,604.10	2,100.00	7,500.00	7,650.00	.....	.....	.....	11.1
162	12	10	5	9	5,377.67	3,680.00	1,200.00	3,074.00	.....	25.0	.....	42.8
163	20	20	27	32	11,500.00	10,138.00	13,500.00	16,000.00	60.0	.....	39.1	.....
164	13	12	12	12	9,360.00	7,850.00	8,000.00	6,875.00	.....	7.7	.....	26.5
165	8	7	7	8	3,615.00	2,588.74	2,800.00	3,500.00	.....	.....	.....	3.2
166	10	10	10	13	6,992.81	6,257.08	7,914.28	7,278.06	30.0	.....	4.1	.....
167	5	6	8	11	2,500.00	3,100.00	3,750.00	4,000.00	120.0	.....	60.0	.....
168	10	5	5	3	3,574.00	2,248.48	2,223.64	627.52	.....	70.0	.....	82.5
169	18	22	25	30	8,936.53	8,300.00	10,800.00	13,250.00	66.7	.....	48.3	.....
170	41	45	60	75	19,931.62	17,000.00	23,409.00	35,000.00	82.9	.....	75.6	.....
Total,	1336	1244	1393	1471	$673,092.67	$541,354.89	$642,587.34	$668,274.59	10.1	.....	.....	.7

* Portion of plant sold and included elsewhere.

INDUSTRY: GENERAL HARDWARE.

Number of establishment.	Persons employed July 1.				Amount paid in wages during year ending July 1.				Per cent. number employed, 1896–1899.		Per cent. amount paid in wages 1896–1899.	
	1896	1897	1898	1899	1896	1897	1898	1899	Increase.	Decrease.	Increase.	Decrease.
171	766	656	765	1009	$431,300.00	$336,000.00	$373,027.00	$481,563.55	31.7	.....	11.7	.....
172	258	238	233	558	144,600.00	68,512.00	68,600.00	176,037.84	116.3	.....	21.7	.....
173	432	372	379	475	172,385.92	150,422.30	164,190.42	201,695.70	10.0	.....	17.0	.....
174	83	81	86	86	46,397.97	33,926.62	42,940.55	44,354.10	3.6	.....	.....	4.4
175	479	413	446	501	245,142.16	207,342.86	224,911.59	256,428.98	4.6	.....	4.6	.....
176	111	100	100	110	52,504.39	50,000.00	52,800.81	53,479.39	.....	.9	1.8	.....
177	50	35	42	50	20,000.00	20,000.00	25,000.00	20,000.00	.....	.....	.....	.....
178	158	192	187	182	70,960.27	68,636.00	86,927.00	84,738.80	15.2	.....	19.4	.....
179	14	13	15	19	7,297.29	6,457.84	6,902.02	11,246.68	35.7	.....	5.41	
180	55	44	44	44	27,655.62	19,527.15	19,387.43	18,815.00	.....	20.0	.....	32.0
181	150	135	160	162	70,000.00	60,000.00	74,512.00	65,000.00	8.0	.....	.....	7.1
182	75	54	66	76	26,144.23	19,595.00	23,245.00	25,812.93	1.3	.....	.....	1.3
183	232	276	325	372	115,946.30	112,380 34	156,015.05	181,790.73	60.3	.....	56.8	.....
184	171	210	206	238	72,559.36	73,324.27	82,300.36	87,513.36	39.2	.....	20.6	.....
185	18	21	21	35	8,345.00	9,000 00	10,000.00	12,978.48	94.4	.....	55.5	.....
186	176	169	183	189	81,000.00	80,000.00	89,242.15	85.057.00	7.4	.....	5.0	.....
187	1500	1300	1200	1350	686,393.00	613,835.71	581,595.72	611,129.72	.....	10.0	.....	11.0
188	200	150	175	278	78,932.00	81,041.52	72,616.40	105,284.92	39.0	.....	33.4	.....
189	12	15	14	14	5,800.00	7,500.00	3,500.00	3,500.00	16.7	.....	.....	39.7
190	1099	1093	1123	1430	506,000.00	413,488.00	416,000.00	505,031.55	30.1	.....	.....	.2
191	911	672	774	924	403,850.00	250,000.00	300,000.00	348,581.00	1.4	.....	.....	13.7
192	15	12	12	20	7,000.00	2,700.00	2,900.00	6,546.86	33.3	.....	.....	6.5
193	85	48	46	26	61,052.01	25,150.21	29,206.15	27,937.53	.....	69.4	.....	5.42
194	16	36	18	14	8,300.00	8,492.79	10,254.53	6,453.89	.....	12.5	.....	22.2
195	65	49	60	75	24,136.65	23,281.18	22,710.00	24,638.09	15.4	.....	2.1	.....
196	55	38	36	45	14,532.15	20,376.70	20,351.24	21,688.02	.....	18.2	49.2	.....
197	45	42	42	46	31,569.00	27,040.00	28,498.00	28,876.00	2.2	.....	.....	8.5
198	48	30	34	43	17,305.00	5,880.00	11,985.23	20,800.00	.....	10.4	20.2	.....
199	10	7	9	24	6,539.70	5,600.00	3,777.00	6,210.00	140.0	.....	.....	5.0
200	33	30	30	46	19,105.00	14,827.00	16,679.00	19,985.00	39.4	.....	4.6	.....
Total,	7322	6531	6831	8441	$ 3,462,753.02	$ 3,814,337.49	$ 3,020,074.65	$ 3,543,175.12	15.3	.....	2.3	.....

INDUSTRY: HATS AND CAPS.

Number of establishment.	Persons employed July 1.				Amount paid in wages during year ending July 1.				Per cent. number employed, 1896–1899.		Per cent. amount paid in wages, 1896–1899.	
	1896	1897	1898	1899	1896	1897	1898	1899	Increase.	Decrease.	Increase.	Decrease.
201	188	125	125	171	$65,850.00	$54,757.11	$57,743.39	$61,996.76	.....	9.0	.....	5.9
202	140	165	205	200	45,000.00	50,000.04	56,000.00	48,000.00	42.9	.....	6.7	.....
203	28	34	16	24	11,951.09	9,000.00	8,752.00	9,557.94	.....	14.3	.....	20.0
204	35	40	25	35	12,000.00	10,048.00	13,056.00	12,071.00	.....	.....	.6	.....
205	80	70	75	65	35,506.00	30,000.00	32,500.00	45,000.00	.....	18.8	26.7	.....
206	47	58	64	59	19,802.50	22,000.00	22,856.27	23,550.00	25.5	.....	18.9	.....
207	89	125	150	128	36,805.81	48,178.11	66,998.65	47,365.83	43.8	.....	28.7	.....
208	70	69	78	85	42,485.22	43,161.42	46,151.00	57,181.45	21.4	.....	34.6	.....
209	62	54	56	57	36,256.88	32,249.80	35,824.28	39,250.00	.....	8.1	8.3	.....
210	30	40	55	60	21,000.00	9,000.00	25,000.00	25,500.00	100.0	.....	21.4	.....
211	141	140	144	146	38,791.47	36,687.78	44,300.89	45,078.18	3.5	.....	16.2	.....
212	204	145	165	200	93,491.34	59,471.55	65,800.00	47,500.00	.....	2.0	.....	49.2
213	10	13	14	12	7,000.00	12,000.00	5,000.00	3,500.00	20.0	.....	.....	50.0
214	200	201	201	225	106,470.00	103,477.97	64,690.18	121,400.00	12.5	.....	14.0	.....
215	50	46	72	72	37,896.40	28,129.00	45,664.00	43,000.00	44.0	.....	13.5	.....
216	267	304	275	281	137,193.04	138,442.94	126,570.90	132,233.71	5.2	.....	.....	3.6
217	28	28	32	32	9,000.00	9,111.00	12,975.00	10,952.00	14.3	.....	21.7	.....
218	65	56	70	79	28,755.75	18,914.86	32,859.78	37,800.00	21.5	.....	31.5	.....
219	28	28	28	28	8,773.63	8,763.23	8,759.21	8,759.24	.....	.....	.....	.2
220	221	254	198	200	100,564.14	102,600.00	103,363.00	98,611.09	.....	9.5	.....	1.9
221	68	60	58	60	23,000.00	22,000.00	23,000.00	23,500.00	.....	11.8	2.2	.....
222	121	120	115	115	71,345.21	71,234.95	71,285 66	75,011.15	.....	4.9	5.1	.....
223	125	42	42	48	42,500.00	14,727.05	7,269.00	18,460.00	.....	61.6	.....	56.6
224	178	225	220	237	103,055.10	103,300.00	101,027.66	122,917.55	32.6	.....	19.3	.....
Total,	2475	2442	2483	2619	$ 1,134,493.58	$ 1,037,254.81	$ 1,077,446.87	$ 1,158,195.90	5.8	.....	2.1	.....

INDUSTRY: HOSIERY AND KNIT GOODS.

Number of establishment.	Persons employed July 1.				Amount paid in wages during year ending July 1.				Per cent. number employed, 1896–1899.		Per cent. amount paid in wages, 1896–1899.	
	1896	1897	1898	1899	1896	1897	1898	1899	Increase.	Decrease.	Increase.	Decrease.
225	66	55	50	52	$21,465.00	$15,661.37	$11,310.94	$11,923.14	.....	21.2	.....	44.5
226	150	132	153	148	53,597.16	47,000.00	52,807.00	53,350.00	.....	1.3	.....	.5
227	146	145	150	150	51,934.31	45,500.00	40,000.00	61,040.87	2.7	.....	17.5	.....
228	166	170	170	170	67,721.34	47,159.72	65,000.00	58,258.62	2.4	.....	.....	14.0
229	170	170	168	172	67,858.79	55,404.57	65,922.98	69,469.25	1.2	.....	2.4	.....
230	165	153	175	205	61,436.39	56,292.83	58,500.00	71,993.45	24.2	.....	17.2	.....
231	115	138	110	110	48,500.00	51,639.00	50,000.00	52,000.00	.....	4.3	7.2	.....
232	181	130	152	153	94,469.67	54,403.32	53,158.69	71,611.87	.....	15.5	.....	24.2
233	130	120	124	132	43,577.31	42,063.41	43,300.00	45,478.11	1.5	.....	4.4	.....
234	32	31	36	39	11,000.00	8,750.00	8,000.00	8,500.00	21.9	.....	.....	22.7
235	265	245	195	348	91,427.11	76,809.88	66,000.00	102,608.00	31.3	.....	12.2	.....
236	39	36	36	35	15,000.00	7,680.79	15,000.00	12,705.21	.....	10.3	.....	15.3
237	152	25	91	106	54,299.78	35,319.74	23,592.78	33,801.75	.....	30.3	.....	37.7
238	110	137	194	169	39,000.00	40,000.00	49,218.00	56,864.00	50.4	.....	45.8	.....
239	375	375	400	500	145,400.00	140,770.00	145,000.00	140,829.00	33.3	.....	.....	3.1
240	100	100	116	100	23,000.00	25,000.00	26,750.00	25,000.00	.....	.....	8.7	.....
241	20	21	20	15	9,895.38	10,448.44	9,327.85	8,472.80	.....	25.0	.....	24.5
242	508	485	475	517	187,302.73	113,792.09	124,810.08	155,792.48	1.8	.....	.....	16.8
Total,	2890	2678	2815	3127	$1,086,884.97	$873,695.16	$907,698.32	$1,038,698.55	8.0	.....	.....	4.4

INDUSTRY: IRON AND IRON FOUNDRIES.

Number of establishment.	Persons employed July 1.				Amount paid in wages during year ending July 1.				Per cent. number employed, 1896–1899.		Per cent. amount paid in wages, 1896–1899.	
	1896	1897	1898	1899	1896	1897	1898	1899	Increase.	Decrease.	Increase.	Decrease.
243	30	25	27	36	$23,785.00	$14,217.00	$16,000.00	$15,000 00	20.0	.....	.....	36.9
244	495	365	432	648	235,293.10	131,819.69	169,299.63	211,631.95	30.9	.....	.....	10.1
245	75	68	80	140	35,724.00	36,435.80	45,500.00	57,200.00	86.7	.....	60.1	.....
246	160	100	110	171	65,854.43	48,000.00	51,323.86	70,544.07	6.9	.....	7.1	.....
247	79	71	70	93	40,966.80	29,817.52	40,196.78	41,825.71	17.7	.....	2.1	.....
248	100	66	94	140	65,000.00	32,600.00	43,300.00	52,319.00	40.0	.....	.....	19.5
249	130	130	106	101	66,370.00	58,300.00	54,607.00	54,000.00	.....	14.6	.....	18.6
250	332	218	316	460	173,843.32	125,263.19	145,846.84	187,404.53	38.6	.....	7.8	.....
251	250	300	325	375	125,000.00	175,000.00	177,000.00	178,700.00	50.0	.....	43.0	.....
252	17	19	21	1	9,352.68	10,400.00	12,100.00	17,800.00	82.4	.....	90.3	.....
253	150	125	153	155	90,000.00	70,000.00	62,000.00	70,000.00	3.3	.....	.....	22.2
254	50	41	45	38	23,282.49	16,810.00	19,300.00	19,293.12	.....	24.0	.....	17.1
255	54	57	51	53	23,000.00	28,000.00	22,000.00	24,532.00	.....	1.1	6.7	.....
256	10	5	5	5	3,500.00	3,429.83	3,200.00	2,080.00	.....	50.0	.....	40.6
257	8	17	19	26	6,000.00	9,700.00	11,500.00	15,900.00	225.0	.....	165.0	.....
258	75	71	80	90	52,000.00	39,000.20	42,000.00	52,000.00	20.0	.....	.....	.....
259	42	40	30	34	20,800.00	23,000.00	20,000.00	15,000.00	.....	19.0	.....	27.9
260	40	30	23	23	18,984.66	20,592.76	14,205.04	8,833.07	.....	32.5	.....	53.5
261	30	40	35	40	16,800.00	16,000.00	16,675.79	17,000.00	33.3	.....	1.2	.....
262	15	7	14	18	9,000.00	4,900.00	8,500.00	8,800.00	20.0	.....	.....	2.2
263	165	175	140	135	89,689.08	80,000.00	70,200.00	57,382.29	.....	18.2	.....	36.0
264	45	35	44	45	25,000.00	19,566.51	25,294.20	25,115.92	.....	.....	.5	.....
265	291	466	548	750	80,352.00	64,777.72	115,802.65	288,000.00	157.8	.....	258.4	.....
266	6	10	6	9	3,350.00	3,600.00	3,636.54	4,200.00	50.0	.....	25.4	.....
267	24	28	28	28	10,000.00	11,000.00	11,000.00	11,500.00	16.7	.....	15.0	.....
268	169	192	281	290	76,970.00	84,887.19	110,845.00	118,754.10	71.6	.....	54.3	.....
269	106	106	135	112	60,000.00	60,000.00	57,600.00	72,800.00	5.7	.....	21.3	.....
270	119	125	145	194	74,794.30	90,186.67	95,099.07	104,627.77	63.0	.....	39.9	.....
271	135	94	80	114	57,795.00	57,714.63	51,340.00	55,840.00	.....	15.6	.....	3.4
272	14	8	12	10	6,000.00	5,500.00	6,700.00	4,800.00	.....	28.6	.....	20.0
273	38	38	34	40	18,859.83	15,577.86	16,418.66	18,479.85	5.3	.....	.....	2.0
274	70	65	60	62	37,808.48	28,433.95	36,944.88	32,673.23	.....	11.4	.....	13.6

INDUSTRY: IRON AND IRON FOUNDRIES — *Concluded.*

Number of establishment.	Persons employed July 1.				Amount paid in wages during year ending July 1.				Per cent. number employed, 1896–1899.		Per cent. amount paid in wages, 1896–1899.	
	1896	1897	1898	1899	1896	1897	1898	1899	Increase.	Decrease.	Increase.	Decrease.
275	58	50	58	55	$27,947.85	$20,526.30	$23,210.35	$26,979.35	.....	5.2	.....	3.5
276	93	70	79	79	34,738.86	32,289.07	29,592.07	34,975.58	.....	15.1	.7	.....
277	50	40	45	48	24,500.00	15,100.00	9,500.00	7,307.85	.....	4.0	.....	70.2
278	14	14	25	17	7,609.00	6,969.23	10,979.93	8,359.30	21.4	.....	9.9	.....
279	54	50	50	50	26,073.91	18,077.51	22,430.53	24,099.38	.....	7.4	.....	7.6
280	169	168	191	195	71,500.00	69,000.00	87,533.36	98,111.79	15.4	.....	37.2	.....
Total,	3762	3529	4997	4910	$1,837,544.79	$1,528,492 63	$1,758,682.18	$2,113,869.86	30.5	.....	15.0	.....

INDUSTRY: LEATHER GOODS.

Number of establishment.	Persons employed July 1.				Amount paid in wages during year ending July 1.				Per cent. number employed, 1896–1899.		Per cent. amount paid in wages, 1896–1899.	
	1896	1897	1898	1499	1896	1897	1898	1899	Increase.	Decrease.	Increase.	Decrease.
281	25	28	26	32	$8,247.60	$7,385.19	$10,201.11	$10,512.97	28.0	.....	27.5	.....
282	16	15	15	22	8,146.14	9,979.00	8,650.00	10,000.00	37.5	.....	22.8	.....
283	6	5	5	5	3,816.00	3,146.00	3,146.00	3,200.00	.....	16.7	.....	16.1
284	94	100	97	126	54,500.00	96,320.00	77,000.00	51,700.00	34.0	.....	.....	5.1
285	25	30	35	35	6,000.00	4,000.00	6,000.00	7,000.00	40.0	.....	16.7	.....
286	25	17	17	25	13,992.00	11,552.51	11,484.16	12,565.33	.....	.....	.....	10.2
287	23	10	10	12	8,057.03	4,580.00	5,200.00	5,000.00	.....	47.8	.....	37.9
288	28	30	29	30	16,743.81	13,500.00	16,438.00	15,031.14	7.1	.....	.....	10.2
289	10	7	12	12	5,200.00	5,000.00	7,800.00	5,500.00	20.0	.....	5.8	.....
290	25	25	26	23	10,000.00	5,000 00	12,708.28	9,871.39	.....	8.0	.....	1.3
291	46	55	41	43	23,803.00	25,000.00	17,000.00	17,500 00	.....	6.5	.....	26.5
292	140	150	180	170	61,578.00	69,707.40	73,714.87	77,826.90	21.4	.....	26.4	.....
293	16	15	16	16	8,000.00	7,200.00	7,650.00	7,800.00	.....	.....	.....	2.5
Total,	479	487	509	551	$228.083.58	$262,370.10	$256,992.42	$233,507.73	15.0	.....	2.4	.....

INDUSTRY: MACHINE SHOPS.

Number of establishment.	Persons employed July 1.				Amount paid in wages during year ending July 1.				Per cent. number employed, 1896–1899.		Per cent. amount paid in wages, 1896–1899.	
	1896	1897	1898	1899	1896	1897	1898	1899	Increase.	Decrease.	Increase.	Decrease.
294	5	7	7	7	$2,367.00	$4,200.00	$3,840.00	$3,800.00	40.0	.....	60.5	.....
295	3	4	4	4	1,550.00	1,600.00	1,575.00	1,500.00	33.3	.....	.....	3.2
296	93	141	223	120	42,215.00	62,744.12	91,118 83	78.508.74	29.0	.....	86.0	.....
297	43	40	32	42	29,680.77	25,447.67	22,072.46	21,047.62	.....	2.3	.....	29.1
298	8	10	8	10	5,597.92	6,500.00	8,190.00	8,200.00	25.0	.....	46.5	.....
299	26	26	27	31	10,703.49	12,955.58	11,289.50	12,539.30	19.2	.....	17.2	.....
300	31	30	38	52	20,000.00	14,495.00	15,603.36	17,361.09	67.7	.....	.....	13.4
301	239	308	286	390	175,843.01	164,805.42	181,700.74	195,554.66	63.2	.....	11.2	.....
302	4	6	6	7	3,000.00	4,160.00	5,634.00	5,824.00	75.0	.....	94.1	.....
303	1130	1012	1022	1005	782,316.90	638,878.63	655,102.86	625,088.78	.....	11.1	.....	20.1
304	50	25	36	44	20,625.00	19,563.09	19,000.00	21,000.00	.....	12.0	1.8	.....
305	5	12	8	10	2.550.00	2,924.12	3,644.43	3,096.44	100.0	.....	21.4	.....
306	50	23	20	30	16,000.00	12,675.80	11,947.50	16,640 00	.....	40.0	4.0	.....
307	106	57	80	110	60,000.00	35,100.00	50,000.00	57,200.00	3.8	.....	.....	4.7
308	27	19	19	25	13,000.00	7,852.44	14,116.00	8,999.97	.....	7.4	.....	30.8
309	10	9	9	9	4,000.00	5,000.00	5,000.00	5,000.00	.....	10.0	25.0	.....
310	15	16	15	18	6,753.00	7,826.00	7,655.00	9,600.00	20.0	.....	42.2	.....
311	18	20	47	48	15,213.57	14,865.69	20,600.97	26,968.73	166.7	.....	77.3	.....
312	77	55	50	25	40,000.00	20,824.32	22,000.00	10,755.23	.....	67.5	.....	73.1
313	9	3	3	4	5,072.00	4,334.00	2,930.25	2,400.00	.....	55.6	.....	52.7
314	421	361	398	445	254,139.23	229,833.95	232,025.88	217,675.00	5.9	.....	.....	14.3
315	8	8	10	10	5,500.00	2,650.00	2,540.00	4,500.00	25.0	.....	.....	18.2
316	20	10	10	12	14,041.00	10,000.00	10,000.00	5,636.34	.....	40.0	.....	59.9
317	32	26	25	24	23,701.00	15,687.00	16,769.88	13,055.53	.....	25.0	.....	44.9
318	14	12	10	10	8,660.00	8,750.00	7,500.00	6,782.00	.....	28.6	.....	21.7
319	15	15	9	9	5,000.00	5,000.00	4,500.00	4,635.00	.....	40.0	.....	7.3
320	72	88	90	110	46,335.90	57,167.06	66,037.44	73,344.82	52.8	.....	58.3	.....
321	65	55	50	60	32,563.19	28,650.00	29,762.50	32,000.00	.....	7.7	.....	1.1
322	55	60	79	84	16,000.00	29,610.00	30,868.00	42,713.00	52.7	.....	167.0	.....
323	108	106	137	180	62,304.00	60,433.00	72,865.75	86,420.71	66.7	.....	38.7	.....
324	6	4	3	5	3,354.11	2,100.00	1,950.00	3.375.00	.....	16.7	.7	.....

INDUSTRY: MACHINE SHOPS — *Continued.*

Number of establishment.	Persons employed July 1.				Amount paid in wages during year ending July 1.				Per cent. number employed, 1896–1899.		Per cent. amount paid in wages, 1896–1899.	
	1896	1897	1898	1899	1896	1897	1898	1899	Increase.	Decrease.	Increase.	Decrease.
325	311	333	191	200	$164,560.00	$267,318.80	$255,181.00	$196,486.39	.....	35.7	19.4	.....
326	1083	1007	681	624	826,018.63	578,000.00	867,427.00	523,616.53	.....	42.4	....	36.6
327	200	213	156	204	89,234.72	106,730.00	108,690.52	100,790.27	2.0	.....	12.9	.....
328	757	855	853	1208	482,549.45	509,606.00	513,794.83	649,190.69	59.6	.....	34.5	.....
329	20	18	26	43	17,699.00	11,992.33	19,212.07	24,765.71	115.0	.....	39.9	.....
330	53	50	60	66	27,000.00	25,711.42	30,395.00	36,620.00	24.5	.....	35.6	.....
331	8	7	6	14	4,768.41	4,146.62	3,718.03	5,415.04	75.0	.....	13.6	.....
332	50	50	37	57	17,000.00	15,000.00	22,000.00	25,881.44	14.0	.....	52.2	.....
333	32	48	50	50	17,896.34	19,788.56	17,198.86	18,000.00	56.3	.....	.6	.....
334	13	16	19	25	2,650.00	4,411.32	7,000.00	7,600.00	92.3	.....	186.8	.....
335	106	106	100	85	65,000.00	43,397.66	48,037.35	54,736.54	.....	19.8	.....	15.8
336	100	54	57	80	60,000.00	36,610.78	38,100.00	46,800.00	.....	20.0	.....	22.0
337	70	100	100	108	43,000.00	50,000.00	62,000.00	53,200.00	54.3	.....	23.7	.....
338	203	267	320	400	108,977.22	125,453.51	130,559.19	162,365.71	97.0	.....	49.0	.....
339	75	60	90	115	37,550.00	30,000.00	40,000.00	50,000.00	53.3	.....	33.2	.....
340	11	14	16	25	8,623.48	7,539.78	9,975.77	12,413.16	127.3	.....	43.9	.....
341	106	132	201	247	61,502.73	63,049.12	84,818.64	113,018.98	133.0	.....	83.8	.....
342	28	35	50	60	12,000.00	13,500.00	16,450.00	17,550.00	114.3	.....	46.3	.....
343	60	58	58	75	33,300.76	30,851.65	39,351.90	45,882.90	25.0	.....	37.8	.....
344	40	40	55	111	25,864.99	19,660.91	24,625.00	40,789.73	117.5	.....	57.7	.....
345	342	260	164	258	162,221.00	130,000.00	82,637.95	114,558.58	.....	24.6	.....	29.4
346	439	406	411	537	282,201.00	237,176.00	301,826.00	400,265.44	22.3	.....	41.8	.....
347	10	12	8	12	7,900.00	7,200.00	4,000.00	4,500.00	20.0	.....	.....	43.0
348	43	41	44	56	16,454.99	13,122.16	13,704.96	15,356.39	30.2	.....	.....	6.7
349	38	41	53	61	16,725.92	13,056.24	19,012.45	21,196.38	60.5	.....	26.7	.....
350	60	60	75	120	25,561.58	24,700.00	32,000.00	51,200.00	100.0	.....	100.3	.....
351	129	66	57	56	81,619.25	49,279.26	35,567.79	37,101.21	.....	56.6	.....	54.5
352	68	83	40	58	29,000.00	43,393.41	18,674.00	34,000.00	.....	14.7	.....	17.2
353	39	36	37	41	19,415.00	18,704.00	19,429.00	21,361.90	5.1	.....	10.0	.....
354	215	205	224	239	72,315.35	84,047.67	89,250.27	98,006.49	11.2	.....	35.7	.....
355	62	15	18	21	24,037.42	24,353.71	21,678.59	12,394.15	.....	61.1	.....	48.4

INDUSTRY: MACHINE SHOPS — *Concluded.*

Number of establishment.	Persons employed July 1.				Amount paid in wages during year ending July 1.				Per cent. number employed, 1896–1899.		Per cent. amount paid in wages, 1896–1899.	
	1896	1897	1898	1899	1896	1897	1898	1899	Increase.	Decrease.	Increase.	Decrease.
356	12	23	26	25	$6,100.00	$10,288.11	$12,000.00	$8,062.00	108.3	.....	32.2	.....
357	47	46	45	46	24,609.00	23,047.00	23,546.00	17,362.00	.....	2.1	.....	29.4
358	85	70	76	91	34,465.33	25,000.00	28,180.00	35,430.00	7.1	.....	2.7	.....
359	118	84	100	100	51,000.00	36,373.67	35,000.00	35,000.00	.....	15.3	.....	31.4
360	10	7	34	51	2,550.00	5,553.00	8,300.00	22,300.00	410.0	.....	774.5	.....
361	178	135	176	178	76,979.06	68,422.00	101,830.11	105,559.62	.....	.....	36.2	.....
362	575	517	505	625	380,000.00	320,000.00	350,000.00	350,000.00	8.7	.....	.....	7.9
363	341	225	313	350	190,000.00	170,000.00	175,000.00	210,000.00	2.6	.....	10.5	.....
364	215	185	192	229	147,300.00	124,500.00	114,700.00	124,962.12	6.5	.....	.....	15.2
365	4	5	7	7	1,800.00	1,880.00	4,200.00	3,000.00	75.0	.....	66.7	.....
Total,	9121	8553	8492	9898	$ 5,485,536.72	$ 4,909,497.58	$ 5,456,912.63	$ 5,517,961.33	8.5	.....	.6	.....

INDUSTRY: MUSICAL INSTRUMENTS AND PARTS

Number of establishment.	Persons employed July .				Amount paid in wages during year endin July 1.				Per cent. number employed, 1896–1899.		Per cent. amount paid in wages, 1896–1899.	
	1896	1897	1898	1899	1896	1897	1898	1899	Increase.	Decrease.	Increase.	Decrease.
366	116	225	230	328	$152,195.00	$95,409.42	$96,300.00	$139,351.51	191.4	.....	.....	8.4
367	50	45	40	25	26,720.57	25,220.00	18,780.54	12,756.82	.....	50.0	.....	52.3
368	86	125	125	148	60,000.00	115,000.00	65,000.00	70,000.00	72.1	.....	16.7	.....
369	10	7	8	8	4,770.00	3,600.00	3,700.00	4,375.00	.....	20.0	.....	8.3
370	155	163	205	247	78,625.82	77,857.00	100,989.12	112,163.42	59.4	.....	42.7	.....
371	8	8	8	8	2,500.00	3,500.00	3,600.00	4,000.00	.....	.....	60.0	.....
372	49	50	50	57	24,510.76	25,712.17	30,621.70	30,485.23	16.3	.....	24.4	.....
373	32	38	45	70	20,000.00	20,000.00	20,000.00	30,000.00	118.7	.....	50.0	.....
374	84	41	43	27	54,019.35	22,519.62	26,538.64	11,918.64	.....	67.9	.....	77.9
Total,	590	702	754	918	$423,341.50	$388,818.21	$365,530.00	$415,050.62	55.6	.....	.....	2.0

INDUSTRY: PAPER AND PAPER GOODS.

Number of establishment.	Persons employed July 1.				Amount paid in wages during year ending July 1.				Per cent. number employed, 1896–1899.		Per cent. amount paid in wages, 1896–1899.	
	1896	1897	1898	1899	1896	1897	1898	1899	Increase.	Decrease.	Increase.	Decrease.
375	18	18	21	20	$7,879.65	$8,078.96	$11,098.02	$11,905.37	11.1	.....	51.1	.....
376	45	44	43	52	15,987.65	15,326.27	15,836.73	19,000.00	15.6	.....	18.8	.....
377	145	160	139	160	50,732.38	56,973.64	49,876.28	53,229.81	10 3	.....	4.9	.....
378	47	44	42	45	18,500.00	13,600.00	13,700.00	14,300.00	.....	4.3	.....	22.7
379	95	70	70	100	33,600.00	30,000.00	24,400.00	33,000.00	5.3	.....	.....	1.8
380	159	144	168	135	58,107.00	59,535.23	70,000.00	42,903.00	.....	15.1	.....	26.2
381	32	32	32	36	14,955.00	15,284.02	15,619.76	18,054.05	12.5	.....	20.7	.....
382	46	48	52	87	27,395.34	25,660.34	26,439.72	30,166.89	89.1	.....	10.1	.....
383	16	16	16	16	7,450.00	7,376.00	6,725.00	6,798.00	.....	.....	.....	8 8
384	16	23	25	45	7,000.00	7,500.00	10,000.00	12,000.00	181.3	.....	71.4	.....
385	210	187	187	165	78,600.52	70,183.30	70,183.00	*24,146.75	.....	21.4	.....	69.3
386	44	35	35	33	22,747.08	19,520 14	16,872.98	15,829.15	.....	25.0	.....	34.1
387	28	28	20	22	9,000.00	7,500.00	6,500.00	7,500.00	.....	21.4	.....	16.7
388	480	480	480	242	185,000.00	200,675.62	195,000.00	88,400.00	.....	49.6	.....	52.2
389	40	40	49	41	12,000.00	11,000.00	11,698.00	11,921.85	2.5	.....	.....	.7
390	14	14	14	14	2,500.00	2,500.00	2,500.00	2,500.00	.....	.....	.....	.....
391	71	76	76	84	24,000 00	25,000 00	25,800.00	29,500.00	18.3	.....	22.9	.....
392	51	47	50	50	20,800.00	18,000.00	19,736.00	20,100.00	.....	2.0	.....	3.5
393	15	17	17	18	5,969.00	5,822.41	6,000.00	6,187.00	20.0	.....	3.7	.....
394	11	9	14	15	4,500.00	3,500.00	5,035.00	5,450 00	36.4	.....	21.1	.....
395	8	10	8	12	3,325.00	4,200.00	3,265.00	3,285.00	50.0	.....	.....	1.2
396	95	68	56	57	31,564.40	21,992.10	21,595.80	17,598.54	.....	40.0	.....	44.2
397	40	41	53	59	16,956.21	16,144.00	12,641.70	19,373 62	47.5	.....	14.3	.....
398	4	22	13	21	1,007.00	4,370 00	2,750.00	2,807.48	425.0	.....	178.8	.....
399	7	7	8	8	3,169.50	2,989.81	3,003.00	3,409.41	14.3	.....	7.6	.....
400	14	13	12	22	4,275.50	3,577.21	4,867.11	5,227.10	57.1	.....	22.3	.....
401	6	7	5	6	1,767.67	1,721.99	1,696.00	1,556.31	.....	.....	.....	12.0
402	90	90	90	90	40,000.00	40,000.00	40,000.00	40,000.00	.....	...	.....	.....
403	19	17	19	25	7,100 00	6,800.00	7,500.00	7,500.00	31.6	.....	5.6	.....
404	66	62	62	70	48,000.00	36,000.00	30,000.00	40,000.00	6.1	.....	.....	16.7

* In operation six (6) months only.

INDUSTRY: PAPER AND PAPER GOODS — *Concluded.*

Number of establishment.	Persons employed July 1.				Amount paid in wages during year endin July 1.				Per cent. number employed, 1896–1899.		Per cent. amount paid in wages, 1896–1899.	
	1896	1897	1898	1899	1896	1897	1898	1899	Increase.	Decrease.	I rease.	Decrease.
405	3	2	2	2	$530.00	$475.00	$750.00	$800.00	.....	33.3	50.9	.....
406	26	30	30	28	8,331.19	7,500.00	8,200.00	10,600.00	7.7	.....	27.2	.....
407	19	19	26	27	12,000.00	10,900.00	14,000.00	18,000.00	42.1	.....	50.0	.....
408	44	38	44	51	24,600.00	21,260.00	23,720.00	24,000.00	15.9	.....	.....	2.0
409	40	40	40	40	13,000.00	10,000.00	13,206.00	15,232.43	.....	.....	17.2	.....
410	80	80	75	85	18,250.00	19,500.00	23,800.00	41,345.00	6.3	.....	126.5	.....
411	62	63	75	72	22,750.00	20,039.00	24,258.00	23,642.00	16.1	.....	3.9	.....
412	25	17	17	20	9,000.00	5,100.00	5,700.00	7,000.00	.....	20.0	.....	22.2
413	18	20	25	25	5,200.00	6,785.65	8,956.25	9,489.75	38.9	.....	82.5	.....
414	44	90	86	97	16,000.00	30,000.00	31,897.76	29,000.00	120.4	.....	81.3	.....
415	65	68	64	75	24,106.00	22,283.39	22,563.66	23,500.00	15.4	.....	.....	2.5
416	35	30	30	40	8,000.00	7,453.02	8,490 77	9,040.57	14.3	.....	13.0	.....
417	15	13	13	14	6,300.00	6,000.00	8,000.00	9,000 00	.....	6.7	42.9	.....
Total,	2404	2259	2303	2326	$931,956.09	$908,127.00	$923,881.54	$814,299.08	.....	3.2	.....	12.6

INDUSTRY: RUBBER GOODS.

Number of establishment.	Persons employed July 1.				Amount paid in wages during year ending July 1.				Per cent. number employed, 1896–1899.		Per cent. amount paid in wages, 1896–1899.	
	1896	1897	1898	1899	1896	1897	1898	1899	Increase.	Decrease.	Increase.	Decrease.
418	70	64	60	66	$31,829.00	$27,700.00	$26,000.00	$33,600.00	.....	5.7	5.6	.....
419	282	292	298	401	207,475.00	226,462.00	237,068.00	214,013.00	42.2	.....	3.2	.....
420	30	30	39	51	14,089.60	11,956.69	15,682.10	20,464.00	70.0	.....	45.2	.....
421	1120	1233	1298	1584	498,100.00	450,044.93	642,050.72	704,038.02	41.4	.....	41.3	.....
422	1100	1500	1400	1150	576,974.65	511,217.78	736,666.17	606,606.52	4.5	.....	5.1	.....
423	16	15	14	14	5,130.63	7,500.00	5,013.00	5,640.00	.....	12.5	9.9	.....
424	175	250	263	200	65,000.00	50,000.00	54,320.00	80,000.00	14.3	.....	23.1	.....
425	44	32	39	58	26,424.21	19,275.08	21,893.10	27,236.00	31.8	.....	3.1	.....
426	50	42	38	32	16,900.00	16,500.00	16,000.00	15,930.64	.....	36.0	.....	5.7
427	260	236	236	220	132,165.36	105,465.91	109,831.72	109,364.56	.....	15.4	.....	17.3
428	75	45	75	83	22,775.88	20,666.84	34,647.83	31,990.00	10.7	.....	84.4	.....
Total,	3222	3739	3760	3859	$ 1,596,864.33	$ 1,446,789.23	$ 1,899,172.64	$ 1,858,882.74	19.8	.....	16.4	.....

INDUSTRY: SHOES.

Number of establishment.	Persons employed July 1.				Amount paid in wages during year ending July 1.				Per cent. number employed, 1896–1899.		Per cent. amount paid in wages, 1896–1899.	
	1896	1897	1898	1899	1896	1897	1898	1899	Increase.	Decrease.	Increase.	Decrease.
429	37	39	40	40	$16,863.15	$15,828.20	$16,700.00	$16,000.00	8.1	.....	.....	5.1
430	67	61	60	62	28,950.00	26,600.00	22,948.00	22,756.00	.....	7.5	.....	21.4
431	80	100	50	55	33,000.00	49,186.60	10,200.00	13,639.81	.....	31.3	.....	58.7
432	30	34	34	35	13,500.00	14,338.92	13,743.55	14,241.15	16.7	.....	5.5	.....
433	12	10	10	10	2,000.00	3,500.00	3,500.00	3,500.00	.....	16.7	75.0	.....
434	65	75	60	55	20,533.77	30,000.00	30,000.00	23,000.00	.....	15.4	12.0	.....
435	75	75	71	75	30,000.00	30,000.00	27,000.00	28,350.00	.....	.....	.....	5.5
Total,	366	394	325	332	$144,846.92	$169,453.72	$124,091.55	$121,486.96	.....	9.3	.....	16.1

INDUSTRY: SILK GOODS.

Number of establishment.	Persons employed July 1.				Amount paid in wages during year ending July 1.				Per cent. number employed, 1896–1899.		Per cent. amount paid in wages, 1896–1899.	
	1896	1897	1898	1899	1896	1897	1898	1899	Increase.	Decrease.	Increase.	Decrease.
436	85	95	121	147	$32,157.37	$27,409.98	$33,132.72	$43,586.63	72.9	.....	35.5	.....
437	99	99	109	214	34,892.15	25,448.90	36,000.00	77,137.27	116.2	.....	121.1	.....
438	550	470	607	716	148,700.00	126,562.90	131,509.20	201,035.42	30.2	.....	35.3	.....
439	50	50	50	65	14,500.00	18,000.00	16,000.00	15,600.00	30.0	.....	7.6	.....
440	37	64	80	100	14,698.49	15,896.52	15,517.50	25,191.50	170.3	.....	71.4	.....
441	50	60	50	60	15,000.00	20,000.00	20,000.00	25,000.00	20.0	.....	66.7	.....
442	38	40	45	48	15,020.00	13,220.65	14,742.34	15,050.00	26.3	.....	.2	.....
443	51	77	125	125	22,510.10	15,600.00	23,000.00	28,000.00	145.1	.....	24.4	.....
444	28	44	52	54	11,311.03	9,934.89	7,463.68	13,756.05	92.9	.....	21.6	.....
445	10	8	20	12	4,700.00	2,500.00	7,500.00	3,800.00	20.0	.....	.....	19.1
446	45	42	58	62	14,835.55	14,017.25	15,076.90	19,706.66	37.8	.....	32.2	.....
447	1913	2093	2235	2460	809,278.00	824,095.10	875,765.75	980,625.50	28.6	.....	21.2	.....
448	375	300	280	308	87,597.48	80,000.00	80,000.00	88,224.24	.....	17.9	.7	.....
449	48	47	55	51	18,200.00	16,224.00	15,600.00	9,149.11	6.3	.....	.....	49.7
450	388	451	512	500	164,679.00	136,743.56	175,221.00	199,000.00	28.9	.....	20.8	.....
451	40	40	214	175	13,000.00	12,400.00	75,000.00	77,630.00	337.5	.....	497.2	.....
Total,	3807	3980	4613	5097	$ 1,421,079.17	$ 1,358,053.75	$ 1,541,529.09	$ 1,822,492.38	33.9	.....	28.2	.....

INDUSTRY: SILVER AND PLATED WARE.

Number of establishment.	Persons employed July 1.				Amount paid in wages during year ending July 1.				Per cent. number employed, 1896–1899.		Per cent. amount paid in wages, 1896–1899.	
	1896	1897	1898	1899	1896	1897	1898	1899	Increase.	Decrease.	Increase.	Decrease.
452	235	217	229	306	$126,735.00	$118,544.16	$129,282.16	$145,000.00	30.2	.....	14.4	.....
453	20	20	20	20	6,433.80	7,658.84	10,999.88	13,040.57	.....	.....	102.7	.....
454	24	23	25	55	8,553.92	11,081.94	17,500.00	15,000.00	129.2	.....	75.4	.....
455	76	66	70	98	43,764.43	31,625.00	40,364.15	34,423 69	28.9	.....	.....	21.3
456	8	8	4	4	3,900.00	3,900.00	2,726.00	1,800.00	.....	50.0	.....	53.8
457	30	29	44	53	15,459.24	14,099.18	18,230.00	22,319.90	76.7	.....	44.4	.....
458	260	220	251	303	71,954.00	77,938.00	88,230.00	104,308.00	16.5	.....	45.0	.....
459	82	80	80	109	42,045.97	44,578.89	38,516.90	40,462 59	32.9	.....	.....	3.8
460	180	180	180	170	89,600.00	80,375.85	90,349.33	93,554.74	.....	5.6	4.4	.....
461	23	23	23	23	10,765.10	9,859.27	10,642.30	11,295.56	.....	.....	4.9	.....
462	884	882	915	1015	429,629.35	425,607.02	492,344.35	561,879.95	14.8	.....	30.8	.....
463	545	540	553	722	286,939.10	267,279.07	315,328.64	305,161.99	32.5	.....	6.7	.....
464	113	95	100	100	63,000.00	51,598 80	52,781.57	61,387.74	.....	11.5	.....	2.6
465	200	200	250	275	85,500.00	94,154.00	111,000.00	132,000.00	37.5	.....	54.4	.....
466	78	72	50	77	32,000.00	25,250.85	18,514.65	22,263 85	.....	1.3	.....	30.4
467	125	125	100	64	68,000.00	52,000.00	50,000.00	42,962.75	.....	48.1	...	36.8
468	127	128	129	136	56,643.83	62,557.01	62,449.16	67,443.89	7.1	.....	19.1	.....
469	109	114	121	125	55,514.00	58,000.00	60,000.00	61,000.00	14.7	.....	9.9	.....
470	20	25	27	28	6,500.00	6,750.00	7,223.45	7,412.83	40.0	.....	14.0	.....
471	6	6	6	6	2,000.00	1,500.00	2,250.00	3,500.00	.....	.....	75.0	.....
472	100	100	107	134	56,809.00	52,589.00	53,583.45	78,200.00	34.0	....	37.7	.....
473	144	120	190	160	84,154.54	64,204 00	98,100.00	70,000.00	11 1	.....	.....	16.8
474	205	215	212	250	104,650.00	89,235.00	100,750 26	115,739.76	22.0	.....	10.6	.....
475	15	12	13	12	6,598 28	4,705.02	6,217.78	6,000.00	.....	20.0	.....	9.1
476	75	75	81	74	48,305.43	44,994.30	47,076 46	49,635.97	.....	1.3	2.8	.....
Total,	3684	3575	3780	4319	$1,804,554.99	$1,700,085.29	$1,924,460.49	$2,065,793.78	17.2	.....	14.5	.....

INDUSTRY: STONE CUTTING AND QUARRYING.

Number of establishment.	Persons employed July 1.				Amount paid in wages during year ending July 1.				Per cent. number employed, 1896–1899.		Per cent. amount paid in wages, 1896–1899.	
	1896	1897	1898	1899	1896	1897	1898	1899	Increase.	Decrease.	Increase.	Decrease.
477	135	152	215	133	$83,000.00	$58,264.22	$54,000.00	$82,659.59	.....	1.5	.....	.4
478	6	2	2	4	4,900.00	800.00	800.00	1,200.00	.....	33 3	.....	75.5
479	22	25	25	31	8,305.00	9,261.75	10,742.62	11,368.46	40.9	.....	36.9	.....
480	167	302	440	200	96,373.00	87,937.19	243,359.20	91,225.04	19.8	.....	.....	5.3
481	4	5	3	3	5,080.00	2,576.00	1,680.00	1,902.10	.....	25.0	.....	62.6
482	10	12	10	6	8,700.00	9,500.00	4,750.00	3,500.00	.....	40.0	.....	59.8
483	169	151	130	128	60,737.82	45,611.73	40,997.01	43,962.37	.....	24.3	.....	27.6
484	215	207	143	183	80,024.00	63,032.38	50,791.64	51,619.77	.....	14.9	.....	35.5
485	6	5	9	8	5,200.00	4,300.00	7,020.00	5,850.00	33.3	.....	12.5	.....
486	11	12	9	10	5,000.00	7,200.00	5,000.00	5,000.00	.....	9.1	.....	.....
Total,	745	873	986	706	$357,319.82	$288,483.27	$419,140.47	$298,287.33	.....	5.2	.....	16.5

INDUSTRY: WIRE AND WIRE GOODS.

Number of establishment.	Persons employed July 1.				Amount paid in wages during year ending July 1.				Per cent. number employed, 1896–1899.		Per cent. amount paid in wages, 1896–1899.	
	1896	1897	1898	1899	1896	1897	1898	1899	Increase.	Decrease.	Increase.	Decrease.
487	11	11	11	13	$5,400.00	$5,400.00	$5,700.00	$6,450.00	18.2	.....	19.4	.....
488	5	3	3	6	3,100.00	1,608.67	2,000.00	2,600.00	20.0	.....	.....	16.1
489	5	4	4	4	1,900.00	1,500.00	3,500.00	2,000.00	.....	20.0	5.3	.....
490	45	60	60	80	18,750.00	16,797.00	17,000.00	24,000.00	77.8	.....	28.0	.....
491	15	15	15	21	8,700.00	7,042.00	6,000.00	8,400.00	40.0	.....	.....	3.4
492	150	146	161	200	77,118.45	74,051.71	71,071.90	87,198.35	33.3	.....	13.1	.....
493	3	3	3	3	2,440.00	1,400.00	1,400.00	1,425.00	.....	.....	.....	41.6
494	175	206	256	275	122,614.46	87,735.57	115,714.00	136,116.58	57.1	.....	11.0	.....
495	150	100	100	125	57,000.00	30,000.00	34,215.25	50,000.00	.....	16.7	.....	12.3
496	125	125	125	160	50,000.00	53,000.00	52,000.00	50,000.00	28.0	.....	.....	.....
497	80	18	13	23	10,000.00	7,200.00	7,662.72	8,034.39	.....	23.3	.....	19.7
498	35	30	34	36	16,574.11	15,175.32	20,170.64	16,207.58	2.9	.....	.....	2.2
499	90	128	130	174	38,476.16	42,872.22	44,923.84	50,719.01	93.3	.....	31.8	.....
500	12	12	22	18	1,880.00	2,000.00	2,592.00	3,400.00	50.0	.....	80.9	.....
501	16	9	8	9	6,429.74	5,344.05	5,335.25	3,464.00	.....	43.8	.....	46.1
502	12	12	13	14	7,500.00	6,375.00	7,280.00	6,500.00	16.7	.....	.....	13.3
Total,	879	882	958	1161	$427,882.92	$357,501.54	$396,565.60	$456,514.91	32.1	.....	6.7	.....

INDUSTRY: WOOD-WORKING.

Number of establishment.	Persons employed July 1.				Amount paid in wages during year ending July 1.				Per cent. number employed, 1896–1899.		Per cent. amount paid in wages, 1896-1899.	
	1896	1897	1898	1899	1896	1897	1898	1899	Increase.	Decrease.	Increase.	Decrease.
503	55	34	41	34	$30,859.74	$25,788.97	$22,052.00	$25,087.11	.....	38.2	.....	18.7
504	81	67	50	55	35,000.00	36,500.00	35,000.00	32,822.65	.....	32.1	.....	8.8
505	30	30	2	30	15,300.00	12,500.00	12,000.00	14,750.00	.....	.....	.....	10.1
506	25	20	21	25	25,000.00	9,000.00	15,000.00	16,000.00	.....	.....	.....	36.0
507	100	98	100	50	31,200.00	32,100.00	33,000.00	26,000.00	.....	50.0	.....	16.7
508	35	35	45	42	20,790.00	18,200.00	25,000.00	25,000.00	20.0	.....	19.5	.....
509	16	12	12	10	8,000.00	7,020.00	7,696.00	6,500.00	.....	37.5	.....	18.8
510	15	15	20	20	8,821.40	7,500.00	10,000.00	10,000.00	33.3	.....	13.4	.....
511	27	30	33	39	19,236.17	15,721.77	18,124.70	23,090.23	44.4	.....	20.0	.....
512	142	145	170	230	78,114.00	80,238 66	77,649.00	70,850.00	62.0	.....	.....	9.3
513	6	6	6	6	3,510.00	3,951.89	4,000.00	3,348.82	.....	.....	.....	4.6
514	55	20	15	30	35,000.00	19,000.00	14,000.00	18,000.00	.....	45.5	.....	48.5
515	25	18	14	6	10,000.00	9,163.00	8,100.00	4,638.93	.....	76.0	.....	53.6
516	18	18	20	20	10,000 00	10,073.00	8,765.00	5,085.00	11.1	.....	.....	49.2
517	5	10	51	12	2,197.65	1,836.71	23,000.00	2,375.06	140.0	.....	8.1	.....
518	52	52	32	58	16,000.00	20,000.00	13,500.00	20,000.00	11.5	.....	25.0	.....
519	10	8	8	9	5,517.71	4,500.00	4,457.00	4,492.48	.....	10.1	.....	18.6
520	27	49	20	20	13,570.00	16,255.39	14,911.73	11,968.46	.....	25.9	.....	11.8
521	25	28	29	28	13,000.00	13,823.00	17,941.02	13,523.63	12.0	.....	4.0	.....
522	60	52	54	65	35,324.31	34,628.11	33,493.65	33,678.47	8.3	.....	.....	4.7
523	14	14	14	13	4,153.57	4,200.00	4,300.00	4,556.02	.....	7.1	9.7	.....
524	4	6	6	10	2,100.00	3,000.00	3,500.00	6,734.00	150.0	.....	221.1	.....
525	9	9	8	11	7,000.00	8,000.00	10,000.00	9,700.00	22.2	.....	38.6	.....
526	20	23	25	24	16,200.00	12,775.00	18,885.49	20,000.00	20.0	.....	23.5	.....
527	14	18	24	20	13,885.00	11,000.00	16,928.32	14,740 00	42.9	.....	6.2	.....
528	13	35	26	16	7,850.00	15,600.00	12,596.00	9,859.13	23.1	.....	25.6	.....
529	40	47	27	33	21,000.00	16,672.00	12,925.09	14,344.09	.....	17.5	.....	31.7
530	309	433	430	500	147,830.00	159,337.77	188,440.00	191,984.86	61.5	.....	29.8	.....
531	4	4	5	6	1,760.00	1,400.00	2,038.00	2,500.00	50.0	.....	42.0	.....
532	225	245	320	356	106,872.98	99,116.92	153,422.11	168,962.81	58.2	.....	58.1	.....
533	25	55	20	29	8,246.29	16,507.20	12,289.10	11,402.64	16.0	.....	38.4	.....

INDUSTRY: WOOD-WORKING — *Continued.*

Number of establishment.	Persons employed July 1.				Amount paid in wages during year ending July 1.				Per cent. number employed, 1896–1897.		Per cent. amount paid in wages, 1896–1899.	
	1896	1897	1898	1899	1896	1897	1898	1899	Increase.	Decrease.	Increase.	Decrease.
534	21	20	45	55	$4,371.28	$6,647.40	$11,428.98	$28,821.44	161.9	.....	100.5	.....
535	44	25	22	23	21,327.64	15,000.00	9,639.55	11,025.84	.....	47.7	.....	48.3
536	46	13	16	16	24,586.44	17,996.00	15,951.73	7,161.42	.....	65.2	.....	70.9
537	27	27	21	21	13,000.00	14,200.00	13,000.00	10,400.00	.....	22.2	.....	20.0
538	56	56	58	58	25,000.00	31,000.00	31,000.00	31,000.00	3.6	.....	24.0	.....
539	85	112	89	149	60,000.00	50,740.87	65,890.00	63,867.96	75.3	.....	6.4	.....
Total,	1765	1889	1919	2129	$912,624.18	$860,993.66	$979,924.47	$973,271.05	20.6	.....	6.6	.....

INDUSTRY: WOOLENS AND WOOLEN MILLS.

Number of establishment.	Persons employed July 1.				Amount paid in wages during year ending July 1.				Per cent. number employed, 1896–1899.		Per cent. amount paid in wages, 1896–1899.	
	1896	1897	1898	1899	1896	1897	1898	1899	Increase.	Decrease.	Increase.	Decrease.
540	175	190	198	135	$56,000.00	$57,500.00	$56,000.00	$35,194.00	.....	22.9	.....	37.2
541	139	138	160	150	46,604.52	48,669.80	60,000.00	45,852 00	7.9	.....	.....	1.6
542	21	80	90	52	8,000.00	28,700.00	36,000.00	31,430.00	147.6	.....	292.9	.....
543	40	46	52	55	12,466.00	11,160.00	18,000 00	19,500.00	37.5	.....	56.5	.....
544	41	41	44	58	12,075.00	14,000.00	15,525 00	17,000.00	41.5	.....	30.0	.....
545	337	274	300	334	140,409.87	86,595.42	110,438.00	115,400.00	.....	.9	.....	17.8
546	45	40	43	45	13,950.00	10,120.00	11,350.00	15,600.00	.....	.....	11.8	.....
547	74	76	79	83	29,615.81	26,428.35	32,525.90	36,786.30	12.2	.....	24.3	.....
548	105	125	114	116	45,000.00	37,000.00	45,000.00	51,000.00	10.5	.....	13.3	.....
549	133	176	167	192	51,800.00	54,000.00	52,000.00	50,600.00	44.4	.....	.....	12.5
550	110	120	120	120	36,000.00	40,000.00	50,000.00	45,000.00	9.1	.....	25.0	.....
551	52	50	53	79	20,058.13	19,259.36	16,914.00	20,833.77	51.9	.....	3.9	.....
552	198	278	175	180	40,001.00	61,052.00	75,580.85	65,824.63	.....	9.1	64.6	.....

INDUSTRY: WOOLENS AND WOOLEN MILLS—*Concl'd.*

Number of establishment.	Persons employed July 1.				Amount paid in wages during year ending July 1.				Per cent. number employed, 1896–1899.		Per cent. amount paid in wages, 1896-1899.	
	1896	1897	1898	1899	1896	1897	1898	1899	Increase.	Decrease.	Increase.	Decrease.
553	300	300	297	350	$90,000.00	$93,000.00	$106,066.40	$98,000.00	16.7	.....	8.9	.....
554	111	112	114	117	42,792.84	33,088.43	43,052.00	39,975.88	5.4	.....	.....	6.6
555	47	59	58	54	19,774.00	12,490.00	18,792.09	19,455.00	14.9	.....	.....	1.6
556	255	244	282	252	91,140.06	75,670.55	96,489.79	105,895.10	.....	1.2	16.2	.....
557	127	139	146	134	37,265.84	39,726.43	40,888.27	38,711.89	5.5	.....	3.9	....
558	70	70	58	64	26,412.32	23,194.60	24,733.28	25,566.50	.....	8.6	.....	3.2
559	1129	1008	903	934	405,524.41	217,251.25	246,512.61	223,016.18	.....	17.3	.....	45.0
560	41	34	36	43	13,145.00	9,000.00	14,500.00	10,716.29	4.9	.....	.....	18.5
561	90	90	95	100	30,000.00	30,000.00	33,500.00	23,800.00	11.1	.....	.....	20.7
562	45	41	40	40	17,500.00	14,319.65	13,724.26	13,093 48	.....	11.1	.....	25.2
563	46	45	48	50	11,350.00	10,396.00	17,000.00	12,000.00	9.1	.....	5.7	.....
564	175	178	172	162	89,933.00	92,820.00	83,265.27	49,023.77	.....	7.4	.....	45.5
565	32	42	33	30	13,890.00	14,980.00	13,500.00	13,355.63	.....	6.3	.....	3.8
566	98	93	100	100	40,070.24	34,505.93	40,000.00	45,000.00	2.0	.....	12.3	.....
567	98	101	103	100	44,941.35	37,063.59	43,353.48	39,221.63	2.0	.....	.....	12.7
568	80	75	100	100	29,000.00	27,000.00	40,000.00	25,000 00	25.0	.....	.....	13.8
569	85	75	60	70	24,044.10	14,802.38	21,971.07	25,304.63	... ..	17.6	5.2	.....
570	159	179	272	261	54,963.26	50,558.96	71,935.12	118,773.26	64.2	.....	116.1	.....
571	300	361	311	280	98,746.00	81,453.77	122,142.83	77,245.13	.....	6.7	.....	21.8
572	90	95	132	85	34,000 00	33,560 00	32,500.00	17,107.00	.....	5.5	.....	49.7
573	42	46	45	45	12,000.00	12,190.00	17,500.00	11,000.00	7.1	.....	.....	8.3
574	130	137	140	140	35,000.00	36,800.00	42,000.00	37,000.00	7.7	.....	5.7	.....
575	35	35	56	57	13,688.76	13,700.00	18,500.00	17,549.68	62.9	.....	28.2	.....
576	97	110	107	112	22,002.86	38,885.08	36,102.79	39,893.90	15.5	.....	81.3	.....
Total,	5152	5303	5303	5279	$1,816,164.37	$1,540,941.55	$1,817,163.01	$1,675,725.65	2.5	.....	.....	7.7

INDUSTRY: MISCELLANEOUS.

Number of establishment.	Persons employed July 1.				Amount paid in wages during year ending July 1.				Per cent. number employed, 1896–1899.		Per cent. amount paid in wages, 1896–1899.	
	1896	1897	1898	1899	1896	1897	1898	1899	Increase.	Decrease.	Increase.	Decrease.
577	13	17	12	17	$7,666.10	$3,914.00	$7,150.53	$8,267.88	.8	.....	7.8	.....
578	20	35	36	34	14,192.80	14,097.00	18,707.00	19,023.13	0.0	.....	34.0	.....
579	20	23	22	28	7,800.00	8,320.67	8,919.93	9,878.14	40.0	.....	26.6	.....
580	70	48	35	35	13,000.00	14,000.00	12,000.00	8,145.09	.....	50.0	.....	37.3
581	4	4	4	5	1,856.43	1,184.22	1,663.91	1,645.97	25.0	.....	.....	11.3
582	20	23	40	36	10,000.00	12,220.00	16,879.24	17,949.03	80.0	.....	79.5	.....
583	30	30	26	40	24,800.00	25,000.00	15,642.00	25,899.00	33.3	.....	4.4	.....
584	4	6	10	10	1,400.00	2,767.25	4,809.00	5,000.00	150.0	.....	257.1	.....
585	33	30	26	37	15,784.41	13,864.45	15,642.65	15,536.24	12.1	.....	.....	1.6
586	5	6	9	8	2,964.80	3,665.80	15,658.72	13,266.60	60.0	.....	347.5	.....
587	14	14	14	19	10,931.80	12,455.95	11,602.00	12,000.00	35.7	.....	9.8	.....
588	17	17	16	18	13,328.00	13,583.00	12,575.00	13,500.00	5.9	.....	1.3	.....
589	22	21	29	30	7,500.00	8,750.00	11,600.00	10,000.00	36.4	.....	33.3	.....
590	9	9	9	9	6,020.41	6,086.00	6,136.00	6,084.00	.....	.....	1.1	.....
591	39	40	36	36	28,600.00	29,328.00	29,640.00	37,700.00	.....	7.7	31.8	.....
592	67	64	65	66	35,000.00	34,000.00	33,000.00	34,354.00	.....	1.5	.....	1.9
593	12	15	16	17	3,850.00	3,900.00	4,500.00	5,000.00	41.7	.....	29.9	.....
594	4	5	6	9	1,800.00	1,800.00	2,500.00	4,000.00	125.0	.....	122.2	.....
595	23	23	25	23	11,573.16	13,446.54	14,184.53	12,764.43	.....	.....	10.3	.....
596	13	16	14	12	6,103.40	6,342.12	6,815.26	6,867.99	.....	7.7	12.5	.....
597	7	6	5	4	2,244.34	2,150.00	2,220.00	2,250.00	.....	42.9	.3	.....
598	37	39	37	45	23,500.00	31,000.00	27,568.72	31,700.00	21.6	.....	34.9	.....
599	20	22	20	20	14,440.00	15,390.00	16,700.00	16,450.00	.....	.....	13.9	.....
600	176	186	173	208	118,245.00	100,269.81	120,000.00	109,883.75	18.2	.....	.....	7.1
601	21	22	18	20	8,672.30	6,920.45	6,866.05	6,825.20	.....	4.8	.....	21.3
602	24	20	21	19	15,703.44	12,710.69	11,113.59	10,057.18	.....	25.0	.....	36.0
603	16	17	18	20	8,000.00	7,500.00	6,600.00	6,500.00	25.0	.....	.....	18.5
604	12	20	15	20	5,000.00	9,000.00	8,000.00	8,000.00	66.7	.....	60.0	.....
605	14	29	30	35	10,000.00	9,768.00	17,000.00	15,300.00	150.0	.....	53.0	.....
606	60	57	56	56	25,620.07	26,000.00	31,200.00	25,480.00	.....	6.7	.....	.5
607	13	13	13	16	4,600.00	5,800.00	6,000.00	8,661.08	23.1	.....	88.3	.....

INDUSTRY: MISCELLANEOUS — *Continued.*

Number of establishment.	Persons employed July 1.				Amount paid in wages during year ending July 1.				Per cent. number employed, 1896–1899.		Per cent. amount paid in wages, 1896–1899.	
	1896	1897	1898	1899	1896	1897	1898	1899	Increase.	Decrease.	Increase.	Decrease.
608	15	9	10	13	$8,146.57	$5,152.00	$5,252.37	$7,369.40	.....	13.3	.....	9.5
609	16	18	19	21	4,500.00	4,700.00	4,600.00	4,504.07	31.3	.....	.1	.....
610	46	31	36	47	21,528.12	19,500.00	22,665.64	17,437.96	2.2	.....	.....	19.0
611	11	10	7	10	4,285.00	3,475.45	1,769.00	4,320.48	.....	9.1	.1	.....
612	14	14	14	12	5,000.00	,000.00	5,000.00	5,000.00	.....	14.3	.....	.....
613	18	25	20	28	7,266.00	8,000.00	8,000.00	9,500.00	55.6	.....	30.8	.....
614	57	68	67	77	27,858.57	28,335.57	32,403.62	34,623.84	35.1	.....	24.3	.....
615	6	10	11	11	2,860.00	5,400.00	3,700.00	3,640.00	83.3	.....	27.3	.....
616	21	25	36	45	12,000.00	11,000.00	16,000.00	19,000.00	114.3	.....	58.3	.....
617	86	87	87	93	31,042.48	29,917.71	30,878.55	32,919.25	8.1	.....	6.0	.....
618	27	27	28	30	12,222.45	11,494.09	11,278.44	13,321.91	11.1	.....	9.0	.....
619	78	95	101	105	60,500.00	62,500.00	67,600.00	72,500.00	34.6	.....	19.8	.....
620	25	25	28	30	15,000.00	15,000.00	14,100.00	15,000.00	20.0	.....	.....	.....
621	32	40	49	50	17,990.20	18,540.26	22,612.57	25,051.36	56.3	.....	39.3	.....
622	35	35	12	12	21,400.00	19,169.00	9,000.00	9,675.00	.....	65.7	.....	54.8
623	82	80	78	93	47,359.21	44,850.56	39,627.50	37,536.00	13.4	.....	.....	20.7
624	6	6	6	6	2,375.75	2,925.08	2,972.31	3,000.00	.....	.....	26.3	.....
625	16	16	16	22	9,000.00	9,000.00	9,000.00	12,100.00	37.5	.....	34.4	.....
626	74	72	68	86	33,380.18	28,571.74	29,573.22	28,872.01	16.2	.....	.....	13.8
627	30	28	32	23	15,000.00	12,827.28	13,979.20	11,015.70	.....	23.3	.....	26.6
628	18	19	19	19	5,908.14	5,825.41	6,241.76	6,644.48	5.6	.....	12.5	.....
629	16	20	20	23	14,820.52	11,811.75	11,800.00	24,057.25	43.8	.....	62.3	.....
630	35	34	33	34	17,791.00	18,200.00	18,970 00	19,000.00	.....	2.9	6.8	.....
631	18	17	16	17	10,677.50	9,000.00	9,000.00	9,500.00	.....	5.9	.....	11.0
632	24	20	21	21	10,963.00	9,000.00	11,200.00	12,750.00	.....	12.5	16.3	.....
633	30	33	40	45	14,000.00	15,200.00	22,000.00	23,375.00	50.0	.....	64.1	.....
634	42	45	43	45	11,000.00	16,000 00	12,000.00	10,000.00	7.1	.....	.....	9.1
635	43	40	40	35	10,620.00	6,000 00	6,000 00	7,000.00	.....	18.6	.....	34.1
636	40	40	42	38	10,000.00	10,114.00	10,500.00	8,500.00	.....	5.0	.....	15.0
637	75	60	50	100	18,000.00	10,500.00	11,600.00	12,000.00	33.3	.....	.....	33.3
638	35	30	23	25	9,000.00	8,500.00	7,620.00	5,474.44	.....	28.6	.....	39.2

INDUSTRY: MISCELLANEOUS — *Concluded.*

Number of establishment.	Persons employed July 1.				Amount paid in wages during year ending July 1.				Per cent. number employed, 1896–1899.		Per cent. amount paid in wages, 1896–1899.	
	1896	1897	1898	1899	1896	1897	1898	1899	Increase.	Decrease.	Increase.	Decrease.
639	59	62	68	75	$19,500.00	$24,500.00	$26,000.00	$28,765.00	31.6	.....	47.5	.....
640	64	65	84	100	20,925.37	17,713.70	28,262.40	31,262.91	56.3	.....	49.4	.....
641	225	220	190	187	100,000.00	85,000 00	84,507.42	121,220.00	.....	16.9	21.2	.....
642	215	250	250	250	82,964.48	75,000.00	121,019.70	75,000 00	16.3	.....	.....	9.6
643	10	10	10	10	5,500.00	6,200.00	7,000 00	7,200.00	.....	.....	30.9	.....
644	25	25	25	33	13,000.00	9,100.00	9,200 00	12,500.00	32.0	.....	.....	3.8
645	15	12	10	8	5,000.00	3,537.28	4,066.75	3,390.62	.....	46.7	.....	32.2
646	5	5	5	5	1,500.00	1,312.41	1,372.39	1,362.38	.....	.....	.....	9.2
647	9	9	8	10	3,950.00	3,741.86	3,650.00	3,698.00	11.1	.....	.....	6.6
648	196	191	175	165	75,187.86	65,650.00	60,000.00	57,223.53	.....	15.8	.....	23.9
649	150	158	155	200	64,000.00	64,171.48	65,000.00	72,410.58	33.3	.....	13.1	.....
650	475	472	496	591	223,000.00	213,000.00	219,000 00	253,000.00	24.4	.....	13.5	.....
651	3	2	2	2	1,560.00	1,350 00	1,050.00	1,100.00	.....	33.3	.....	29.5
652	19	16	15	19	9,600.00	7,200.00	8,500.00	8,500.00	.....	.....	.....	11.5
653	8	9	11	6	3,500.00	4,316.00	5,000.00	3,500.00	.....	25.0	.....	.....
654	57	54	55	75	14,706.00	19,862.00	27,073.50	30,104.05	31.6	.....	104.7	.....
655	6	8	7	7	3,927.63	3,591.77	4,193.12	3,257.49	16.7	.....	.....	17.1
656	12	13	10	13	7,450.00	7,538.48	7,473.17	6,848.00	8.3	.....	.....	8.1
657	11	8	8	9	5,000.00	3,506.85	3,492.67	3,609.48	.....	18.2	.....	27.8
658	6	6	5	5	2,148.55	2,083.00	1,968.14	1,746.04	.....	16.7	.....	18.7
659	9	9	7	8	5,500.00	5,500.00	5,000.00	5,200.00	.....	11.1	.....	5.5
660	41	22	15	23	18,200.00	15,363.20	14,139.88	7,962.17	.....	43.9	....	56.3
661	12	18	11	14	4,200.00	4,500.00	6,000.00	5,216.98	16.7	.....	24.2	.....
662	21	12	9	12	10,400.00	7,200.00	3,900.00	4,000.00	.....	42.9	.....	61.5
663	63	50	20	6	21,600 00	26,000.00	13,500.00	3,249.64	.....	90.5	.....	85.0
664	15	25	36	72	8,000.00	6,623.28	11,871 00	24,913.39	380.0	.....	211.4	.....
665	23	23	23	16	6,750.00	7,020.00	9,332.00	7,500.00	.....	30.4	11.1	.....
666	12	12	10	10	6,000.00	5,940.00	5,500.00	3,000.00	.....	16.7	.....	50.0
667	16	28	17	13	10,006.11	11,194.44	8,265.41	7,474.53	.....	18.8	.....	31.5
668	12	12	12	24	9,261.45	8,638.69	9,637.20	10,965.98	100.0	.....	18.4	.....
Total,	3704	3762	3677	4136	$ 1,714,928.60	$ 1,637,098.29	$ 1,754,804.06	$ 1,817,857.63	11.7	.....	6.0	.....

AVERAGES.

NDUSTRY.	Average number employed July 1, 1896–1899.	Number of persons employed July 1, 1899.	Average amount paid in wages, 1896–1899.	Amount paid in wages during year ending July 1, 1899.	Per cent. No. employed July 1, 1899, compared with average 1896–9.		Per cent. amt. paid in wages 1899, compared with average 1896–9.	
					Increase.	Decrease.	Increase.	Decrease.
Brass and Brass Goods,	15,266	17,528	$7,379,888.88	$8,304,561.89	14.8	.....	12.5	.....
Carriages and Carriage Parts,	639	699	404.427.49	420,679.79	9.4	.....	4.0	.....
Corsets.	4,659	4,840	1,495,888.06	1,571,879.26	3.9	.....	5.1	.....
Cotton Goods,	4,558	4,789	1,511,926.76	1,587,640.52	5.1	.....	5.0	.....
Cotton Mills,	8,657	8,793	2,646,621.37	2,654,485.89	1.6	.....	.3	.....
Cutlery and Tools,	1,361	1,471	631,327.37	668,274.59	8.1	.....	5.9	.....
General Hardware,	7,281	8,441	3,460,085.07	3,543,175.12	15.9	.....	2.4	.....
Hats and Caps,	2,505	2,619	1,101,847.79	1,158,195.90	4.6	.....	5.1	.....
Hosiery and Knit Goods,	2,876	3,121	976,744.25	1,038,698 55	8.5	.....	6.3	.....
Iron and Iron Foundries,	4,050	4,910	1,809,647.36	2,113,869.86	21.2	.....	16.8	.....
Leather Goods,	507	551	245,238.46	233,507.73	8.7	.....	.....	4 8
Machine Shops,	9,016	9,898	5,342,477.07	5,517,961.33	9.8	.....	3.3	.....
Musical Instruments and Parts,	741	918	398,185.08	415,050.62	23.9	.....	4.2	.....
Paper and Paper Goods,	2,323	2,326	894,565.93	814,299.08	.1	.....	.....	9.0
Rubber Goods,	3,645	3,859	1,700,427.23	1,858,882.74	5.9	.....	9.3	.....
Shoes,	354	332	139,969.79	121,486.96	.....	6.2	.....	13.2
Silk Goods,	4.374	5,097	1,535,788.60	1,822,492.38	16.5	.....	18.7	.....
Silver and Plated Ware,	3,840	4,319	1,873,723.64	2,065,793.78	12.5	.....	10.3	.....
Stone Cutting and Quarrying,	827	706	340,807.72	298,287.33	.....	14.6	.....	12.5
Wire and Wire Goods,	970	1,161	409,616.24	456,514 91	19.7	.....	11.4	.....
Wood-Working,	1,925	2,129	931,703.34	973,271.05	10.6	.....	4.5	.....
Woolens and Woolen Mills,	5,259	5,279	1,712,498.65	1,675,725.65	.4	.....	.....	2.1
Miscellaneous,	3,820	4,136	1,731,172.14	1,817,857.63	8.3	.....	5.0	.....
Totals,	89,453	97.922	$38,674,578.29	$41,132,592.56	9 5	.....	6.4	.....

RECAPITULATION.

INDUSTRY.	Number of Establishments Reporting.	Persons Employed July 1st.				Amount Paid in Wages during Year Ending July 1st.				Per cent. Number Employed, 1896–1899.		Per cent. Amt. Paid in Wages, 1896–1899.	
		1896	1897	1898	1899	1896	1897	1898	1899	Increase.	Decrease.	Increase.	Decrease.
Brass and Brass Goods,	64	13,864	13,773	15,900	17,528	$7,075,744.59	$6,487,882.72	$7,651,366.33	$8,304,561.89	26.4	.....	17.4	.....
Carriages and Carriage Parts,	15	613	601	643	699	413,944.24	386,196.88	396,889.04	420,679.79	14.0	.....	1.6	.....
Corsets,	10	4,425	4,632	4,738	4,840	1,450,626.44	1,409,195.73	1,551,850.80	1,571,879.26	9.4	.....	8.4	.....
Cotton Goods,	28	4,376	4,388	4,680	4,789	1,567,119.83	1,341,284.28	1,551,662.40	1,587,640.52	9.4	.....	1.3	.....
Cotton Mills,	23	8,414	8,630	8,792	8,793	2,610,349.98	2,546,637.69	2,775,011.91	2,654,485.89	4.5	.....	1.7	.....
Cutlery and Tools,	30	1,336	1,244	1,393	1,471	673,092.67	541,354.89	642,587.34	668,274.59	10.1	.....	.....	.7
General Hardware,	30	7,322	6,531	6,831	8,441	3,462,753.02	3,814,337.49	3,020,074.65	3,543,175.12	15.3	.....	2.3	.....
Hats and Caps,	24	2,475	2,442	2,483	2,619	1,134,493.58	1,037,254.81	1,077,446.87	1,158,195.90	5.8	.....	2.1	.....
Hosiery and Knit Goods,	18	2,890	2,678	2,815	3,121	1,086,884.97	873,695.16	907,698.32	1,038,698.55	8.0	.....	.....	4.4
Iron and Iron Foundries,	38	3,762	3,529	3,997	4,910	1,837,544.79	1,528,492.63	1,758,682.18	2,113,869.86	30.5	.....	15.0	.....
Leather Goods,	13	479	487	509	551	228,083.58	262,370.10	256,992.42	233,507.73	15.0	.....	2.4	.....
Machine Shops,	72	9,121	8,553	8,492	9,898	5,485,536.72	4,909,497.58	5,456,912.63	5,517,961.33	8.5	.....	.6	.....
Musical Instruments and Parts,	9	590	702	754	918	423,341.50	388,818.21	365,530.00	415,050.62	55.6	.....	.....	2.0
Paper and Paper Goods,	43	2,404	2,259	2,303	2,326	931,956.09	908,127.00	923,881.54	814,299.08	.....	3.2	.....	12.6
Rubber Goods,	11	3,222	3,739	3,760	3,859	1,596,864.33	1,446,789.23	1,899,172.64	1,858,882.74	19.8	.....	16.4	.....
Shoes,	7	366	394	325	332	144,846.92	169,453.72	124,091.55	121,486.96	.....	9.3	.....	16.1
Silk Goods,	16	3,807	3,980	4,613	5,097	1,421,079.17	1,358,053.75	1,541,529.09	1,822,492.38	33.9	.....	28.2	.....
Silver and Plated Ware,	25	3,684	3,575	3,780	4,319	1,804,554.99	1,700,085.29	1,924,460.49	2,065,793.78	17.2	.....	14.5	.....
Stone Cutting and Quarrying,	10	745	873	986	706	357,319.82	288,483.27	419,140.47	298,287.33	.....	5.2	.....	16.5
Wire and Wire Goods,	16	879	882	958	1,161	427,882.92	357,501.54	396,565.60	456,514.91	32.1	.....	6.7	.....
Wood-Working,	37	1,765	1,889	1,919	2,129	912,624.18	860,993.66	979,924.47	973,271.05	20.6	.....	6.6	.....
Woolens and Woolen Mills,	37	5,152	5,303	5,303	5,279	1,816,164.37	1,540,941.55	1,817,163.01	1,675,725.65	2.5	.....	.....	7.7
Miscellaneous,	92	3,704	3,762	3,677	4,136	1,714,928.60	1,637,098.29	1,754,804.06	1,817,857.63	11.7	.....	6.0	.....
Total,	668	85,395	84,846	89,651	97,922	$38,577,737.30	$35,794,545.47	$39,193,437.81	$41,132,592.56	14.7	.....	6.6	.....

STATISTICS OF MANUFACTURES.

ANALYSIS BY INDUSTRIES.

The element which commends the main character of the following analysis is the clearness and accuracy of the data from which the deductions are drawn. It has been the purpose to exhibit, in this chapter of the report, the industrial conditions exactly as they have been found to exist, and to make the division by industries in such a way as to present the whole subjective matter before the reader in a manner which may be easily comprehended.

It must be borne in mind that in making the division above mentioned it has been the purpose to show as nearly as possible the kind or class of goods manufactured by the various establishments represented in the subdivision, and to carry out this plan the following descriptive analysis is presented.

It is interesting to note in this connection that of the twenty-three classified industries as represented by the 668 establishments considered, but three show a decrease in the number employed in 1899 from the number on the pay-rolls of the same establishments in 1896, and but two exhibit a decrease in 1899 from the average number employed during the four-year period covered by the investigation.

The number of classified industries which show a decrease in the amount paid in wages in 1899 from that disbursed in 1896, however, is seven, while the number paying less in 1899 than the average for the period from 1896 to 1899 is five. This statement of fact, drawn from information secured from sources which are authentic and absolutely true, cannot fail to be most gratifying to everyone concerned in the prosperity of the manufacturing industries of Connecticut.

BRASS AND BRASS GOODS.

Classified in the tables under the caption of brass and brass goods are manufacturers of brass and copper wire, faucets, sheet and plumbers' specialties of brass, lamps and lamp burners, manufacturers of bronze, sleigh, bicycle, door, and call bells, copper and brass tubing, rods, rivets, eyelets, clocks and clock movements, watches, toys made wholly or in part of brass, gas, electric, and display fixtures, bedsteads, brass castings, and novelties.

Represented in the tables are sixty-four establishments engaged in the above-described industries. The reports from these establishments show 17,528 persons as having been employed in them on July 1, 1899, as against 13,864 at the corresponding date in 1896, and an average number of 15,266 for the four years up to and including 1899, an increase in number employed in 1899 over 1896 of 26.4 per cent., the increase in the same year over the average for the four years contemplated being 14.8 per cent. The showing in the amount paid in wages is as follows:

Wages paid in 1896, $7,075,744.59, in 1899, $8,304,561.89, an increase of 17.4 per cent. Average amount paid in wages during the years 1896, 1897, 1898, and 1899, $7,379,888.88; increase in 1899 over the average for the four years, 12.5 per cent.

CARRIAGES AND CARRIAGE PARTS.

Following the same analytical process in presenting the condition of this industry, without the accompaniment of the same amount of detail as in the foregoing, it is found that 699 persons were employed July 1, 1899, in the 15 establishments considered, 613 being the number employed at the same date in 1896, the average number for the period 1896 to 1899 inclusive, being 639, the increase in the latter over the former named year being 14 per cent. and over the average 9.4 per cent.

In amount paid in wages, the increase in 1899 over the average for four years was 4 per cent., while the increase in amount paid in wages in 1899 over the amount paid by the same establishments in 1896 was but 1.6 per cent.

CORSETS.

Manufacturers of corsets to the number of ten made reports to the Bureau, 4,840 persons being employed by them on July 1, 1899, as against 4,425 on the corresponding date in 1896, the increase in the number employed in 1899 over 1896 being 9.4 per cent. Making the same comparison with amounts paid in wages during the same periods, it is found that the increase was 8.4 per cent. The increase in the number employed in 1899 over the average number for the four years considered was 3.9 per cent., and the amount paid in wages increased 5.1 per cent.

COTTON GOODS.

Included among the 28 establishments classified as manufacturers of cotton goods, are those concerns producing laundered shirts, cotton batts, threads and yarns, clothes lines, cotton warp, rope, cords, twines, netting, canvass, webbing, etc. On July 1, 1899, 4,789 was the number employed by all establishments which made returns, 4,376 being the number on the pay-rolls of the identical concerns on the corresponding date in 1896, thus showing an increase in 1899 over 1896 of 9.4 per cent. The increase in number employed at the former-named date over the average for the four-year period being 5.1 per cent. The increase in the amount paid in wages during the year ending July 1, 1899, over the amount paid during the same period in 1896 was 1.3 per cent., and over the average for the four years 5 per cent.

COTTON MILLS.

The number of establishments reporting, which were engaged in the production of cotton cloths, lawns, tarlatans, buckram, prints, sateens, denims, tickings, duck, sheetings, shirtings, and twills, was 23, having 8,793 persons on their various pay-rolls on July 1, 1899, an increase of 4.5 per cent. over the number employed in the same establishments at the same date in 1896, while the increase over the average for the entire period covered by the investigation was but 1.6 per cent. In the amount paid for wages, the increase in 1899 over the earlier period was 1.7 per cent., and over the average for four years .3 per cent.

CUTLERY AND TOOLS.

Among the 30 establishments classified under this head are manufacturers of table and pocket cutlery, cast iron and steel shears, scissors, razors, machine needles, awls, scythes, hay, corn, and farrier knives, augers and auger bits, bit braces, carpenter, mechanics', and machine tools, axes, edge and boring tools, hand and breast drills, rules, planes, levels, hoes, hack saws, files and rasps, ink erasers, tool-sets, screw-drivers, pliers, water, gas, and steam fitters' tools, dies, stamps, stencils, seals, etc. In the industries thus classified, there was an increase in the number employed on July 1, 1899, over the number employed by the same establishments at the same date in 1896, of 10.1 per cent., while a decrease of .7 per cent. in the amount paid in wages during the later period is shown. Following the rule of averages, however, it appears that the increase in the number employed in 1899 over the average for the four-year period was 8.1 per cent., and in the amount paid in wages the increase was 5.9 per cent.

GENERAL HARDWARE.

The number of establishments classified as manufacturers of general hardware, which made reports to the Bureau, was 30, and embraces producers of all kinds of builders' and furniture hardware, including rim and mortise door, cabinet, sash, and trunk locks, padlocks, hames, casters, butts, hinges, carriage, saddlery, and marine hardware. The increase in the number employed on July 1, 1899, over the number on the pay-rolls of the same establishments at the same date in 1896 was 15.3 per cent., and over the average for four years ending July 1, 1899, 15.9 per cent., while the wages paid increased in 1899 over the average for the four-year period 2.4 per cent., and over 1896 2.3 per cent.

HATS AND CAPS.

In the hat and cap industry there are 24 establishments which made reports to the Bureau, showing an increase of 5.8 per cent. in the number employed on July 1, 1899, over the number of employes in the same establishments in 1896, and 4.6 per cent. over the average for the years 1896, 1897, 1898, and 1899. The per-

centage of increase in the amount paid in wages during the year ending at the later over the year closing at the former date was 2.1 per cent., and over the average for the four-year period 5.1 per cent.

HOSIERY AND KNIT GOODS.

Engaged in the manufacture of knit underwear, there are 18 establishments included in the tabulation, showing an increase in the number employed on July 1, 1899, over 1896 of 8 per cent., and over the average for the four years last past of 8.5 per cent. A decrease of 4.4 per cent. is shown in the amount paid in wages during the year ending at the later period from the corresponding date in 1896, but an increase of 6.3 per cent. is shown in the amount paid in wages during the year ending July 1, 1899, over the average amount disbursed during the four years ending at that date.

IRON AND IRON FOUNDRIES.

Manufacturers of iron goods and proprietors of iron foundries to the number of 38 reported, making the gratifying showing of 30.5 per cent. increase in the number employed on July 1, 1899, over the number of persons on the pay-rolls of the same establishments at the same date in 1896, and 21.2 per cent. increase over the average number employed during the four years covered by the investigation. The increase in the amount paid in wages in 1899, however, was but 15 per cent. over the amount paid by the same concerns in 1896, while the increase in wages paid in 1899 over the average amount paid for four years ending July 1st of that year was 16.8 per cent.

LEATHER GOODS.

But 13 manufacturers of leather goods made reports to the Bureau. The increase in the number employed July 1, 1899, over 1896 being 15 per cent. and over the average for the four-year period 8.7 per cent. The increase in the amount paid in wages by these establishments during the year ending July 1, 1899, over the amount paid by them during the year ending at the same date in 1896 was 2.4 per cent. The amount disbursed in

1899, however, was 4.8 per cent. less than was the average amount distributed during the four years ending July 1st of that year.

MACHINE SHOPS.

The term "Machine Shop" as used in the tabulation refers to those establishments which do general and special machine work, jobbing, manufacturers of typewriting machines, bicycles and bicycle chains, hat, woodworking, and grinding machinery, lathe, drill, and planer chucks, engines, printing presses, emery wheels, tumbling barrels, sewing, sawing, and screw machines, organ motors, power and punching presses, headers and drops, steam regulators, paper feeders and cutters, gear cutters, electric machinery, pipe threading and cutting machines, etc. The number of establishments making the returns contained in this classification is 72, the reports from them showing an increase of 8.5 per cent. in the number employed on July 1, 1899, over the corresponding period in 1896, and 9.8 per cent. increase over the average number employed during the four-year term considered. In the amount paid in wages the increase in 1899 over the amount paid in 1896 was but .6 per cent., while the figures for 1899 show an increase over the average amount paid during the four-year period of 3.3 per cent.

MUSICAL INSTRUMENTS AND PARTS.

But nine establishments classified under this head are shown in the tables, and while the figures as to the number on their several pay-rolls show an increase in 1899 over 1896 of 55.6 per cent., the decrease in the amount paid in wages during the later from the amount paid during the former period is 2 per cent., the increase in the number employed in 1899 over the average for four years being 23.9, and the wages paid in 1899 was 4.2 per cent. greater than the average amount paid for four years ending July 1st of that year.

PAPER AND PAPER GOODS.

This is one of the three classified industries which shows a decrease, both in number employed and amount paid in wages in

1899, compared with the figures for 1896. There are 43 establishments represented in the tabulation. The decrease in the number employed on July 1, 1899, from the number on the pay-rolls of the identical concerns at the same date in 1896 being 3.2 per cent. The decrease in the amount paid in wages, making the same comparison, is 12.6 per cent. Comparing the number employed in 1899 with the average for the four-year period, an increase of .1 per cent. is found, while the amount paid in wages during the year ending July 1, 1899, was 9 per cent. less than was the average amount paid during the years 1896, 1897, 1898, and 1899.

RUBBER GOODS.

The condition of the rubber industry appears very different from that just considered, for the 11 establishments represented show an increase in the number employed July 1, 1899, over the number of persons on the pay-rolls of the same establishments on the same date in 1896 of 19.8 per cent., while the distribution of wages during the same period and by the same establishments increased 16.4 per cent., the increase in the number employed in 1899 over the average for the four-year period being 5.9 per cent., and in amount paid in wages 9.3 per cent.

SHOES.

The shoe industry is represented in the tabulation by only seven establishments, this enterprise apparently not being one which thrives as do others in Connecticut. A decrease is shown, both in the number employed and the amount paid in wages during the year 1899, as compared to the conditions which obtained in 1896, the percentage of decrease being 9.3 per cent. in the former and 16.1 per cent. in the latter case. Averages being considered, however, the decrease in the number of persons on pay-rolls of these establishments on July 1, 1899, was 6.2 per cent. less than was the average number employed in the same establishments during the four years ending at that date, and the amount paid in wages 13.2 per cent. less.

SILK GOODS.

A condition different from the foregoing is shown in the silk industry, which, apparently, is most prosperous. The number of employes on the pay-rolls of the 16 establishments considered increased 33.9 per cent. in 1899 over the number employed in the same establishments at the same date in 1896. The increase shown in the amount distributed as wages, the same dates being considered, is 28.2 per cent. The increase in the amount paid during the year ending July 1, 1899, over the average amount disbursed during the four years ending at that date is 18.7 per cent., and the number employed in 1899, compared with the average number during the four-year period, increased 16.5 per cent.

SILVER AND PLATED WARE.

A most gratifying condition is also found in this industry. The 25 establishments included in the tabulation report an increase in the number of employes on their several pay-rolls on July 1, 1899, over the number employed in the same establishments on the same date in 1896 of 17.2 per cent. The same dates being considered, the increase in the amount disbursed as wages was 14.5 per cent. The amount paid in wages during the year ending July 1, 1899, as compared with the average amount disbursed by the same firms during the years 1896, 1897, 1898, and 1899 increased but 10.3 per cent., while the number employed on July 1st of the latter named year, shows an increase over the average number for the four-year period of 12.5 per cent.

STONE CUTTING AND QUARRYING.

Ten concerns, only, engaged in this industry made reports to the Bureau. The limited number doubtless accounts for the unfavorable condition shown. The decrease in the number employed on July 1, 1899, from the number on the pay-rolls of the same establishments on the same date in 1896 was 5.2 per cent., while the wages paid, the same establishments and same dates being considered, decreased 16.5 per cent. The decrease in the number employed in 1899, as compared with the average for the four years included in the tabulation, was 14.6 per cent.,

and the amount paid in wages in 1899 decreased 12.5 per cent. from the average amount disbursed during the four-year period.

WIRE AND WIRE GOODS.

Manufacturers of wire and wire goods to the number of 16 made reports to the Bureau. The increase in the number employed by them on July 1, 1899, over the number of persons on their pay-rolls on the same date in 1896 being 32.1 per cent. The wages paid in 1899 increased over the amount disbursed in 1896, 6.7 per cent., and over the average for the four years ending July 1, 1899, 11.4 per cent., while the number of employes in 1899 increased over the average number employed during the same time 19.7 per cent.

WOOD WORKING.

Thirty-seven establishments under this classification are considered in the tabulation. The reports from them show, in the aggregate, an increase in the number employed on July 1, 1899, over the number of persons on their pay-rolls for the same date in 1896 of 20.6 per cent. The increase in the number of employes over the average number during the four years ending on the first-named date being 10.6 per cent. Comparing the amount disbursed as wages during the year ending July 1, 1899, with the amount paid out on the same account during the year ending July 1, 1896, it is found that the increase was 6.6 per cent., and over the average amount distributed during the four years ending July 1, 1899, 4.5 per cent.

WOOLENS AND WOOLEN MILLS.

The reports from 37 establishments engaged in the manufacture of woolens show an increase in the number employed on July 1, 1899, over the number of persons on the pay-rolls of the same establishments on the same date in 1896 of 2.5 per cent., while the amount paid out by them as wages during the year ending the subsequent date, as compared with the amount disbursed during the year ending on the earlier date, decreased 7.7 per cent. The increase in the number employed in 1899 over the average for the four years previous to and ending on July 1st of

that year was .4 per cent., the wage account decreasing in 1899 from the average amount distributed during the four-year period 2.1 per cent.

MISCELLANEOUS.

The reports from 92 establishments are classified as "miscellaneous" in the tabulation, and include producers of electrotypes, autotypes, lithographs, photo engravings, crucibles, decorated lamp globes and glass novelties, corks, mattresses, varnish, acids, fuse, gun and blasting powder, statuary, blank books, indexes, starch, soap, brushes, paints, pottery, japans, lime, marine oakum, lager beer, ale beer, and porter, mantels, bone and steel notions, and other specialties.

All the industries thus classified show an increase in the number of persons on the various pay-rolls on July 1, 1899, over the number employed on the same date in 1896 of 11.7 per cent., and an increase over the average number employed during the years 1896, 1897, 1898, and 1899 of 8.3 per cent. The amount paid in wages by these manufacturers during the year ending July 1, 1899, was 6 per cent. larger than was disbursed during the corresponding period in 1896, and 5 per cent. more than was the average annual amount distributed as wages during the four years ending July 1, 1899.

Part III

Free Public Employment Offices

1 THEIR NEED

2 OPERATION

3 RESULTS

4 ILLINOIS

5 MISSOURI

6 NEW YORK

7 OHIO

FREE PUBLIC EMPLOYMENT OFFICES.

CONNECTICUT'S NEED OF THEM. OPERATION IN OTHER STATES.

Located in nearly all the large cities of the State there are at present numerous employment or intelligence offices which have been or are conducted for private profit rather than for public good. Their managers are engaged in grasping the hard earned money of the poor by charging fees for the supposed service of securing employment for the applicants. These private agencies charge men and women from one dollar upwards for securing for them employment, and, in some cases, they demand and receive a price for accepting an application whether they secure a place or not. This every honest citizen knows to be wrong, because it is evident that when men and women are willing to labor but are unable to find work it is burdensome enough for them to suffer the hardships which are inseparable from enforced idleness without their being taxed for the privilege of securing work or for someone's promise to secure work for them.

So much interest has been manifested in this subject, not only by working men and women but by students of economics as well, and so many inquiries have come to this Bureau from officials and citizens of other states concerning employment offices that it has been deemed best to present in this report some of the causes which led up to the enactment of free employment agency laws in other states, and to give the result of their practical operation in those localities where free public employment offices have been established.

It is doubtless true that the destitute unemployed in large

cities constitute, for the time, a dependent class, as helpless as and more dangerous to the body politic than those unfortunates who are so abundantly provided for by public charities. Present conditions develop a class who prey upon these needy people in their want, and thus aggravate not only the individual desperation, but the social disease which it begets. It is easily in the power of the State to anticipate and alleviate, to a great extent, this evil.

With the development of industrial interests has arisen the necessity for employment agencies. The practices of unscrupulous men, ever ready to take advantage of the necessities of the unemployed, have directed public attention to this question. The result has been that free offices, under the management of the State, have been opened in many sections of the country. The experience of those states takes from such an undertaking all the uncertainty of an experiment. Fortunately the recent substantial improvement in the industrial conditions of the country has somewhat reduced the necessity for such agencies so far as those seeking for labor are concerned. The growing wants of parties who employ labor and appreciate its increasing scarcity, however, should not be forgotten. The benefits which would accrue from the establishment of free employment agencies would be of nearly as great value to them as to the unemployed.

Very little is generally known either concerning the hardships which the private agencies impose upon multitudes of worthy and willing poor or, on the other hand, concerning the efforts which have been made through the governmental agencies in this and other countries to deliver the working people from this form of oppression.

On account of the varied need of help in the widely diversified industries of this State, and because of the great army of skilled and unskilled laborers who seek employment herein, Connecticut furnishes a wide field for the permanent establishment of free employment offices for the gratuitous guidance and assistance of those whose uninterrupted employment is so closely allied to and which vitally affects the public welfare. The work could be

undertaken by this Bureau with but little cost to the State, and the necessary legislation to inaugurate the system would be simple.

The following extract is from an address delivered by Hon. David Ross, secretary of the Illinois State Board of Labor Statistics, at the opening of the free employment offices in the city of Chicago in August last:

As showing the extent of the field for such legislative effort in our own borders, it is shown that in the city of Boston, with less than half the population of Chicago, 119 private employment agencies received over 600,000 applications for work during one year; also that in St. Louis, six private agencies received over 100,000 applications in the same period, and that in Kansas City, 88,000 applications were made in a year to twelve private agencies; moreover, that all these figures are notorious understatements, having been obtained from the private agents themselves, all whose interests lie in minimizing the real number. But, assuming the substantial completeness of the figures given for the city of Boston, which are doubtless the most trustworthy we have, and applying them to the 196 private agencies which were licensed in the city of Chicago in 1896, we are confronted with the startling probability that during periods of depression approximately 1,000,000 applications for work must be made in the course of a year to the tribute gathering offices in this city.

EMPLOYMENT AGENCIES IN EUROPE.

As an evidence of the efficiency of the free service rendered at public cost by the various home and foreign governments, we find that partial returns from the various municipal offices in the city of Paris show that in the year 1897, employment was secured, without cost to the applicant, for 47,979 persons, and that in the first ten months of 1898, work was found for 26,270 others, and this, notwithstanding the fact that free agencies are also maintained in that city by 421 different trade unions, by seventy-six convents, and by fifty-nine friendly societies.

The five so-called "labor bureaus" in London, and five in other cities of England, together with the agencies of the Salvation Army and of the Association for Befriending Young Servants, secured situations, free of charge, in 1898, for 14,994 persons out of 16,382 who made application; in addition to these, fifteen temporary registries were established for various periods, and special permanent offices have long been maintained in London for securing, without charge, employment for seamen, for discharged soldiers, for reserve corps soldiers, for army and navy pensioners, and for discharged prisoners. The free employment agencies in Germany secured, during the year ended July, 1898, occupation for 222,595 idle persons out of 387,991 who sought occupation.

The result of the operation of the law creating offices of this kind in

the state of Ohio is found to be a total of 103,112 situations secured in the five cities, Cincinnati, Cleveland, Columbus, Dayton, and Toledo. In St. Louis an office imperfectly equipped obtained situations in 1898 for 4,661 men and women out of work. The California office, in 1896, had 18,920 applications, and found places for 7,983 unemployed poor.

Attention is drawn to the further fact of significance that it is not alone those who patronize the private agencies who need the sort of relief afforded by a free public service. There is a class who have no last dollar to lose — who have already lost it in the intelligence office or in the purchase of bread, and who cannot even command the equivocal services of the private agency. One man conducting such an office in St. Louis says that only about half the number applying to him for work are able to pay the fee necessary for registration. What shall be said of these? The man who needs employment most of all is the man who really has nothing at all. These are the submerged, the helpless, the hopeless — a constant menace to society — for whom there is no relief except in such state help as will enable them to recover their footing and again become self-helping contributors to the common weal.

England, France, Germany, Bavaria, New Zealand, Australia, and even Russia, representatives alike of the oldest and of the youngest civilizations, as well as numerous cities in this country, have all reached the common conviction by a common experience, that the needs of the unemployed are of legitimate concern to the state.

The law of the State of Illinois creating free employment agencies in certain cities in that State is presented herewith:

FREE EMPLOYMENT AGENCIES IN CERTAIN CITIES.

SEC. 1. Creation of in certain cities—number in each city—purpose—name.

SEC. 2. Superintendents and assistants — how appointed — salaries.

SEC. 3. Location of offices—rooms—duties of superintendent—records, separate registers — form of — not open to public.

SEC. 4. Superintendent to report to bureau of labor statistics each week — circulation of such reports.

SEC. 5. Superintendent to correspond with employers and advertise for employment — each office allowed $400 for advertising.

SEC. 6. Superintendent to make annual report to bureau of labor statistics.

SEC. 7. No fee charged applicants — penalty for receiving fee.

SEC. 8. No employes to be furnished in case of strike or lockout.

SEC. 9. Defines terms "applicant for employment" and "applicant for help."

SEC. 10. Private agencies to procure license—amount of license—bond — similarity of name to that of State agency prohibited — penalty for violation.

SEC. 11. Grounds for removal of superintendent.

SEC. 12. Secretary of State to furnish printing for agencies.

AN ACT *to create free employment offices in cities of certain designated populations, and to provide for the maintenance, management, and control of the same, and to prevent private imitations of the name of the same and regulating private employment agencies.*

SECTION 1. *Be it enacted by the people of the State of Illinois, represented in the General Assembly:* That free employment offices are hereby created as follows: One in each city of not less than fifty thousand population, and three in each city containing a population of one million or over, for the purpose of receiving applications of persons seeking employment, and applications of persons seeking to employ labor. Such offices shall be designated and known as Illinois Free Employment Offices.

SEC. 2. Within sixty days after this act shall have been in force, the State board of commissioners of labor shall recommend, and the Governor, with the advice and consent of the Senate, shall appoint a superintendent and assistant superintendent and a clerk for each of the offices created by Section 1 of this act, and who shall devote their entire time to the duties of their respective offices. The assistant superintendent or the clerk shall in each case be a woman. The tenure of such appointment shall be two years, unless sooner removed for cause. The salary of each superintendent shall be $1,200 per annum, the salary of such assistant superintendent shall be $900 per annum. The salary of such clerks shall be $800 per annum, which sums, together with the proper amounts for defraying the necessary costs of equipping and maintaining the respective offices, shall be paid out of any funds in the State treasury not otherwise appropriated.

SEC. 3. The superintendent of each such free employment office shall, within sixty days after appointment, open an office in such locality as shall have been agreed upon between such superintendent and the secretary of the Bureau of Labor Statistics as being most appropriate for the purpose intended; such office to be provided with a sufficient number of rooms or apartments to enable him to provide, and he shall so provide, a separate room or apartment for the use of women registering for situations or help. Upon the outside of each such office, in the position and manner to secure the fullest public attention, shall be placed a sign which shall read in the English language, Illinois Free Employment Office, and the same shall appear either upon the outside windows or upon signs in such other languages as the location of each such office shall render advisable. The superintendent of each such free employment office shall receive and record in books kept for that purpose names of all persons applying for employment or help, designating opposite the name and address of each applicant the character of employment or help desired. Separate registers for applicants for employment shall be kept, showing the age, sex, nativity, trade, or occupation of each applicant, the cause and duration of non-employment, whether married or single, the number of dependent children, together with such other facts as may be required by the bureau of labor statistics to be used by said bureau: *Provided*, that no such special registers shall be open to public inspection at any time, and that such

statistical and sociological data as the bureau of labor may require shall be held in confidence by said bureau, and so published as not to reveal the identity of any one: *And, provided,* further, that any applicant who shall decline to furnish answers to the questions contained in special registers shall not thereby forfeit any rights to any employment the office might secure.

SEC. 4. Each such superintendent shall report on Thursday of each week to the State Bureau of Labor Statistics the number of applications for positions and for help received during the preceding week, also those unfilled applications remaining on the books at the beginning of the week. Such lists shall not contain the names or addresses of any applicant, but shall show the number of situations desired and the number of persons wanted at each specified trade or occupation. It shall also show the number and character of the positions secured during the preceding week. Upon receipt of these lists, and not later than Saturday of each week, the secretary of the said bureau of labor statistics shall cause to be printed a sheet showing separately and in combination the lists received from all such free employment offices; and he shall cause a sufficient number of such sheets to be printed to enable him to mail, and he shall so mail, on Saturday of each week, two of said sheets to each superintendent of a free employment office, one to be filed by said superintendent, and one to be conspicuously posted in each such office. A copy of such sheet shall also be mailed on each Saturday by the secretary of the State Bureau of Labor Statistics to each State inspector of factories and each state inspector of mines. And it is hereby made the duty of said factory inspectors and coal mine inspectors to do all they reasonably can to assist in securing situations for such applicants for work, and describe the character of work and cause of the scarcity of workmen, and to secure for the free employment offices the co-operation of the employers of labor in factories and mines. It shall be the duty of such factory inspectors and coal mine inspectors to immediately notify the superintendent of free employment offices of any and all vacancies or opportunities for employment that shall come to their notice.

SEC. 5. It shall be the duty of each such superintendent of a free employment office to immediately put himself in comunication with the principal manufacturers, merchants, and other employers of labor, and to use all diligence in securing the co-operation of the said employers of labor, with the purposes and objects of said employment offices. To this end it shall be competent for such superintendents to advertise in the columns of daily newspapers for such situations as he has applicants to fill, and he may advertise in a general way for the co-operation of large contractors and employers in such trade journals or special publications as reach such employers, whether such trade or special journals are published within the state of Illinois or not: *Provided,* that not more than four hundred dollars, or as much thereof as shall be necessary, shall be expended by the superintendent of any one such office for advertising any one year.

SEC. 6. It shall be the duty of each such superintendent to make report

to the State Bureau of Labor Statistics annually, not later than December first of each year, concerning the work of his office for the year ending October first of same year, together with a statement of the expenses of the same, including the charges of an interpreter when necessary, and such reports shall be published by the said Bureau of Labor Statistics annually with its coal report. Each such superintendent shall also perform such other duties in the collection of statistics of labor, as the secretary of the Bureau of Labor Statistics may require.

SEC. 7. No fee or compensation shall be charged or received, directly or indirectly, from persons applying for employment or help through said free employment offices; and any superintendent, assistant superintendent, or clerk, who shall accept, directly or indirectly, any fee or compensation from any applicant, or from his or her representative, shall be deemed guilty of a misdemeanor, and, upon conviction, shall be fined not less than twenty-five nor more than fifty dollars and imprisoned in the county jail not more than thirty days.

SEC. 8. In no case shall the superintendent of any free employment office created by this act, furnish or cause to be furnished, workmen or other employes to any applicant for help whose employes are at that time on strike, or locked out; nor shall any list of names and addresses of applicants for employment be shown to any employer whose employes are on strike or locked out; nor shall such list be exposed where it can be copied or used by an employer whose employes are on strike or locked out.

SEC. 9. The term "applicant for employment" as used in this act shall be construed to mean any person seeking work of any lawful character, and "applicant for help" shall mean any person or persons seeking help in any legitimate enterprise; and nothing in this act shall be construed to limit the meaning of the term work to manual occupation, but it shall include professional service, and any and all other legitimate services.

SEC. 10. No person, firm, or corporation in the cities, designated in Section 1, of this act, shall open, operate, or maintain a private employment agency for hire, or where a fee is charged to either applicants for employment or for help, without first having obtained a license from the Secretary of State, which license shall be two hundred dollars per annum, and who shall be required to give a bond to the people of the state of Illinois in the penal sum of one thousand dollars, for the faithful performance of the duties of private employment agent; and no such private agent shall print, publish, or paint on any sign, window, or newspaper publication, a name similar to that of the Illinois Free Employment Offices. And any person, firm, or corporation violating the provisions of this act, or any part thereof, shall be deemed guilty of a misdemeanor, and upon conviction shall be fined not less than fifty nor more than one hundred dollars.

SEC. 11. Whenever, in the opinion of the Board of Commissioners of Labor, the superintendent of any free employment office is not duly diligent or energetic in the performance of his duties, they may summon such superintendent to appear before them and show cause why he should not be recommended to the Governor for removal, and unless such cause is clearly

shown the said board may so recommend. In the consideration of such case an unexplained low percentage of positions secured to applicants for situations and help registered, lack of intelligent interest and application to the work, or a general inaptitude or inefficiency, shall be considered by said board a sufficient ground upon which to recommend a removal. And if, in the opinion of the Governor, such lack of efficiency cannot be remedied by reproval and discipline, he shall remove as recommended by said board: *Provided*, that the Governor may at any time remove any superintendent, assistant superintendent, or clerk for cause.

SEC. 12. All such printing, blanks, blank books, stationery, and postage as may be necessary for the proper conduct of the business of the offices herein created shall be furnished by the Secretary of State upon requisition for the same made by the Secretary of the Bureau of Labor Statistics.

Approved April 11, 1899. In force July 1, 1899.

OPERATION OF THE LAW IN ILLINOIS.

The courtesy of Secretary Ross of the Illinois Bureau of Labor Statistics has enabled this Bureau to present in detail the results attained by the three free employment offices established in the city of Chicago on August 1 of the current year. Weekly reports from the superintendents of these offices, covering the business transacted by each during every week from August 1, 1899, up to and including October 28, 1899, have been received at this office. These have been compiled with a view to simplicity, that the reader may readily comprehend them.

The character of positions applied for and the kinds of help wanted, applications for which were filed at the three offices during the three months covered by the reports, are as follows:

Males.

Any occupation,
Apprentices,
Architects,
Bakers,
Barbers,
Barnmen,
Bartenders,
Bell boys,
Beer bottlers,
Bicycle workers,
Blacksmiths,
Boiler-makers,
Bookbinders,
Bookkeepers,
Boxmakers,
Brass finishers,
Bricklayers,
Brushmakers,
Buggy-washers,
Butchers,
Butlers,
Canmakers,
Candy-makers,
Canvassers,

Carbuilders,
Carcleaners,
Carpenters,
Cashiers,
Cigar-makers,
Civil Engineer,
Clerical work,
Clerks,
Clerks and salesmen,
Coachmen,
Collectors,
Compositors,
Cooks,
Delivery boys,
Dish-washers,
Draughtsmen,
Drill-press men,
Drivers,
Druggist,
Dyer,
Electrical linemen,
Electricians,
Elevator men,
Engineers,
Factory hands,
Farm help,
Firemen,
Glass-bevelers,
Hodcarriers,
Horseshoers,
Hostlers,
Hotel clerks,
Inventors,
Ironworkers,
Janitors,
Kitchen help,
Laborers,
Laundrymen,
Law students,
Lime mixer,
Locksmiths,
Lumber inspector,
Machinists,
Merchants,
Metal-workers,
Mill-workers,
Miners,
Miscellaneous,
Molder helpers,
Music teachers,
Nickel plater,
Nurses,
Office boys,
Packers,
Painters,
Paper rulers,
Pattern makers,
Piano tuners,
Plasterers and masons,
Photographers,
Plumbers,
Polishers,
Porters,
Pressmen,
Printers,
Railroad laborers,
Sailors,
Salesmen,
Sawyers,
Second cooks,
Shipping clerks,
Shoemakers,
Solicitors,
Steam-fitters,
Stenographers,
Stockkeepers,
Stonemasons,
Tailors,
Tailors and cutters,
Teachers,
Teamsters,
Timekeepers,
Tinsmiths,
Truckmen,
Undertakers,
Upholsterers,
Vegetable men,
Vestmakers,
Vise hands,
Wagon-drivers,
Waiters,
Watchmen,
Whitewashers,
Wholesale house,

Window dressers,
Window washers,
Woodfinishers,
Woodworkers.

Females.

Bookkeepers,
Cash girls,
Canvassers,
Cashiers,
Chambermaids,
Circular folders,
Clerks,
Commercial help,
Compositors,
Companions,
Cooks,
Copyists,
Day workers,
Dining-room help,
Dishwashers,
Domestics,
Domestic help,
Dressmakers,
Factory workers,
General housework,
Governess,
Housekeepers,
Janitresses,
Kitchen help,
Laundresses,
Matrons,
Miscellaneous,
Nurses,
Office work,
Pantry work,
Reception lady,
Restaurant scrubbing,
Saleswomen,
Scrubwomen,
Seamstresses,
Second workers,
Solicitor,
Stenographers,
Teachers,
Waitresses.

SUMMARY OF THE THREE OFFICES.

August 1, 1899, to October 28, 1899.

	Applications for Employment.			Applications for Help.	
	Number filed.	Number of positions secured.	Number unfilled.	Number filed.	Number unfilled.
Males, . . .	12,348	5,820	6,528	8,597	2,777
Females, . .	4,741	4,383	358	5,678	1,295
Total, . . .	17,089	10,203	6,886	14,275	4,072

As will be seen by the foregoing, the total number of applications for employment filed in the three offices in the city of Chicago during the three months ending October 28, 1899, was 17,089, and the number of positions secured for the applicants through the medium of the agencies was 10,203, thus showing that 59.7 per cent. of those applying for employment were sup-

plied with positions. Divided as to sex, the percentage of positions furnished to female applicants is larger than is the case as to males, for, as will be discovered, the number of applications for employment filed by males was 12,348 and the number of positions secured was 5,820, which is 47.1 per cent. of the number of applications filed. In the case of applications for positions filed by females, the proportion of them applying which were furnished with employment is 92.4 per cent.

These facts, however, while going far to show the benefits derived from the establishment of these offices, does not present the entire advantage of the enterprise; for it will be noticed that there were 8,597 applications filed for male and 5,678 for female help, a total of 14,275. Deducting from the total number of applications for help the number supplied with situations, it is found that there are 4,072 applications for help unsupplied, and, moreover, while the table shows that 6,886 applicants for employment had not been furnished with positions, the demand for help was still unsatisfied. Obviously the reason for this can be explained only by presuming that the class of help required by those employers making applications had not applied for employment and could not be secured through the means at the command of the agencies.

Surely the Bureau of Labor Statistics of the State of Illinois, the State itself, and the city of Chicago particularly, are to be congratulated upon the most excellent showing made by the free public employment offices during the first three months of their operation.

THE LAW OF THE STATE OF OHIO CONCERNING EMPLOYMENT OFFICES.

AN ACT

To amend section 308 of the Revised Statutes of Ohio.

SECTION 1. *Be it enacted by the General Assembly of the State of Ohio,* That section 308 of the Revised Statutes be so amended as to read as follows:

SEC. 308. The commissioner shall have an office in the state house, which shall be a bureau of statistics of labor, and he shall collect, arrange, and systematize all statistics relating to the various branches of labor in the state, and especially those relating to the commercial, industrial, social, educational, and sanitary conditions of the laboring classes. Said

commissioner is hereby authorized and directed, immediately after the passage of this act, to organize and establish in all cities of the first class, and cities of the first and second grade of the second class in the State of Ohio, a free public employment office, and shall appoint one superintendent for each of said offices to discharge the duties hereinafter set forth. Said superintendent shall cause to be posted in front of their said offices on a sign board, or in a suitable place on the building where such offices are located, the words, " Free Public Employment Office." It shall be the duty of such superintendent to receive all applications for labor of those desiring employment and those desiring to employ labor, and record their names in a book kept for that purpose, designating opposite the name of each applicant the character of employment or labor desired, and the address of such applicant. Each of the said superintendents shall be provided with such clerical assistance as in the judgment of the commissioner may appear necessary for properly conducting the duties of their several offices.

No compensation or fee shall, directly or indirectly, be charged to or received from any person or persons seeking employment, or any person or persons desiring to employ labor through any of said offices. Said superintendents shall make a weekly report on Thursday of each week to said commissioner of all persons desiring to employ labor, and the class thereof, and all persons applying for employment through their respective offices, and the character of employment desired by each applicant; also, of all persons securing employment through their respective offices and the character thereof, and a semi-annual report of the expense of maintaining such offices. Said commissioner shall cause to be printed weekly a list of all applicants and the character of employment desired by them, and of those desiring to employ labor, and the class thereof, received by him from the respective offices aforesaid, and cause a true copy of such list on Monday of each week to be mailed to the superintendent of each of said offices in the state, which said list by the superintendent shall be posted immediately, on receipt thereof, in a conspicuous place in his office, subject to the inspection of all persons desiring employment. Said superintendents shall perform such other duties in the collection of labor statistics as said commissioner shall determine. Any superintendent or clerk, as herein provided, who directly or indirectly charges or receives any compensation from any person whomsoever in securing employment or labor for any other person or persons, as provided in this act, shall be deemed guilty of a misdemeanor and be fined in any sum not exceeding fifty dollars and imprisoned in the county jail or workhouse not exceeding thirty days. The superintendent of each of said offices shall receive a salary, to be fixed by the council of such city, payable monthly. The clerk or clerks required in any such offices shall receive a salary of not more than fifty dollars per month; provided the compensation of such superintendents and clerks so appointed shall be paid out of the city treasury in which such free public employment office may be located.

SEC. 2. That said original section 308 of the Revised Statutes be and the same is hereby repealed.

SEC. 3. This act shall take effect and be in force from and after its passage.

Passed April 28, 1890.

SECTION 1. *Be it enacted by the General Assembly of the State of Ohio,* That section 308 of the Revised Statutes be supplemented with the following section:

SEC. 308*a*. The tenure of office for all superintendents and clerks of free public employment offices shall be two years from the date of appointment, but the commissioner of labor statistics shall have the power of removing any of such superintendents and clerks for good and sufficient cause, and all appointments and removals of such superintendents and clerks shall be made with the consent of the governor.

SEC. 2. This act shall take effect and be in force from and after its passage.

Passed March 24, 1891.

Ohio was the first State to create free public employment offices. The last report of the Commissioner of the Bureau of Labor Statistics of that State contains the following, concerning their operation:

The Municipal Labor Congress of Cincinnati, an organization composed of all the trades and labor unions in that city, started the agitation in favor of something of this kind in all the large cities of the state. The law creating them was, undoubtedly, an experimental departure in legislation. The result of that act has been a success. I am glad to say that these offices stand well in favor with employers of labor, and workingmen and women consider it a great privilege to have a place of this kind in their city where they can go for information or to secure employment without being charged a fee or being imposed upon in any way. If the kind of work they desire can be had they get it freely. The army of idle men seeking situations has been alarmingly great in cities at times, and few of our people are cognizant of the expense to which the laboring people are often subject to in seeking employment through private intelligence offices.

Before the inauguration of the free public employment offices by the state these pay offices were springing up on every corner, and were getting fat by their methods of doing business. There are now but a few of them left, and where they still exist they are not working in that high-handed manner as was the case a few years ago.

This bureau has been enabled to secure data from the free public employment offices established in Ohio and located in the cities of Cincinnati, Cleveland, Toledo, Columbus, and Dayton for the years from 1890 to 1897, inclusive, and the appended tables for each year, together with the summary, will serve to convince the reader of the success of the operation of the law.

Tables of Cincinnati, Cleveland, Toledo, Columbus, and Dayton Employment Offices.

Year 1890.	Situations wanted.		Help wanted.		Positions secured.	
	Males.	Females.	Males.	Females.	Males.	Females.
Cincinnati,	4,763	1,818	2,803	2,787	1,830	1,126
Cleveland,	2,523	1,277	3,189	1,231	1,333	847
Columbus,	1,965	710	1,192	722	684	525
Toledo,	2,334	719	2,885	1,083	1,329	497
Dayton,	2,944	1,083	1,384	878	399	418
Totals,	14,529	5,607	11,453	6,701	5,575	3,413

Year 1891.	Situations wanted.		Help wanted.		Positions secured.	
	Males.	Females.	Males.	Females.	Males.	Females.
Cincinnati,	4,811	3,428	3,369	3,291	2,312	2,129
Cleveland,	6,308	3,830	925	3,471	886	2,508
Columbus,	3,128	1,739	1,534	2,268	915	1,481
Toledo,	3,859	1,799	2,481	2,479	2,064	1,391
Dayton,	3,351	2,118	1,386	2,004	790	1,119
Totals,	21,457	12,914	9,695	13,513	6,967	8,628

Year 1892.	Situations wanted.		Help wanted.		Positions secured.	
	Males.	Females.	Males.	Females.	Males.	Females.
Cincinnati,	3,139	2,789	1,980	2,782	1,497	1,613
Cleveland,	3,655	3,539	1,162	4,587	1,000	2,664
Columbus,	2,908	1,658	2,013	2,162	1,244	1,152
Toledo,	3,160	1,964	1,810	2,654	1,361	1,442
Dayton,	2,671	1,474	1,282	1,770	883	989
Totals,	15,533	11,424	8,247	13,955	5,985	7,860

Year 1893.	Situations wanted.		Help wanted.		Positions secured.	
	Males.	Females.	Males.	Females.	Males.	Females.
Cincinnati,	2,740	2,536	1,344	2,531	933	1,541
Cleveland,	2,964	4,157	935	2,671	768	2,825
Columbus,	3,219	2,060	1,142	1,879	1,165	1,165
Toledo,	2,194	2,099	792	2,032	579	1,477
Dayton,	3,052	1,833	1,613	2,290	1,121	1,627
Totals,	14,169	12,685	5,826	11,403	4,566	8,635

Year 1894.	Situations wanted.		Help wanted.		Positions secured.	
	Males.	Females.	Males.	Females.	Males.	Females.
Cincinnati, . .	2,778	3,162	297	1,383	267	1,144
Cleveland, . .	2,942	3,517	283	2,065	273	1,846
Columbus, . .	2,672	2,226	605	1,852	456	1,343
Toledo, . . .	2,472	1,950	441	1,693	367	1,359
Dayton, . .	3,657	3,761	800	2,447	777	1,934
Totals, . .	14,521	14,616	2,426	9,440	2,140	7,626

Year 1895.	Situations wanted.		Help wanted.		Positions secured.	
	Males.	Females.	Males.	Females.	Males.	Females.
Cincinnati, . .	2,442	2,774	326	1,995	319	1,592
Cleveland, . .	1,980	2,732	450	2,963	444	2,009
Columbus, . .	2,887	2,187	725	2,358	499	1,590
Toledo, . . .	3,167	1,649	645	1,659	547	1,236
Dayton, . .	3,689	4,451	905	3,197	868	2,621
Totals, . .	14,165	13,793	3,041	12,172	2 677	9,048

Year 1896.	Situations wanted.		Help wanted.		Positions secured.	
	Males.	Females.	Males.	Females.	Males.	Females.
Cincinnati, . .	1,821	2,181	262	1,568	237	1,233
Cleveland, . .	1,290	3,479	323	3,720	323	2,691
Columbus, . .	3,422	2,476	700	2,350	585	1,928
Toledo, . . .	2,557	1,937	909	1,885	836	1,616
Dayton, . .	3,578	4,957	884	3,109	800	2,696
Totals, . .	12,668	15,030	3,078	12,632	2,781	10,164

It will be seen from the foregoing that of the 14,529 males who applied for positions through the five offices in the cities named during the year 1890, 5,575 or 38.4 per cent. were supplied with employment, while of the 5,607 females who made applications for employment, 3,413 or 60.9 per cent. were furnished with situations. Positions being secured for 44.6 per cent. of the total number of persons, including both male and female, applying for work through the medium of the agencies.

Obviously the value of the offices was becoming better known in 1891, for during that year the number of applications for situations materially increased, the number of males who applied be-

ing 21,457 and of females 12,914, 32.5 per cent. of the former and 66.8 per cent. of the latter being supplied with positions. In 1892 the percentage of males who applied for positions and were furnished with employment was 38.5 per cent. and of the females 68.8 per cent.

Of the number of males who applied during 1893, 32.2 per cent. were supplied with positions, while 68.1 per cent. of the females who made applications for situations were furnished with employment.

It will be noticed that, during the remainder of the term covered by the reports of the five offices, the number of applications for employment gradually decreased. The following summary of the total amount of business done during the seven years included in the tabulation presents interesting information in respect to the results attained and the benefits derived from the establishment of free public employment offices, in so far as the State of Ohio is concerned.

GRAND TOTALS TO JANUARY 1, 1897, OF ALL BUSINESS TRANSACTED IN THE FREE PUBLIC EMPLOYMENT OFFICE OF THE STATE, SINCE OPENING OFFICES.

	Male.			Female.			Total business.
	Situations wanted.	Help wanted.	Positions secured.	Situations wanted.	Help wanted.	Positions secured.	
Cincinnati, .	22,494	10,381	7,395	18,688	16,337	10,378	85,673
Dayton, .	22,942	8,254	5,638	19,677	15,695	11,404	83,610
Columbus, .	20,201	7,911	5,548	13,056	13,591	9,184	69,491
Cleveland, .	21,662	7,267	5,027	22,531	20,708	15,390	92,585
Toledo, .	19,743	9,963	7,083	12,117	13,485	9,018	71,409
Totals, .	107,042	43,776	30,691	86,069	79,816	55,374	402,768

The foregoing table exhibits the total amount of business transacted in the Ohio free public employment agencies during the seven years ending January 1, 1897. It will be noticed that the total number of applications for situations, including males and females, was 193,111, of which 86,065 or 44.5 per cent. were furnished with employment. Divided as to sex, the result is reached that 28.7 per cent. of the male and 64.3 per cent. of the

female applicants for employment were supplied with situations through the operation of the law establishing free employment offices. It is obvious, therefore, that the greater benefits derived from the institution of these offices under the auspices of the State go to the unemployed female. This, however, is in degree only, and, moreover, it must be remembered in making comparisons that, by the data presented it appears that of the total number of applications for help 64.6 per cent. was for female, and 35.4 per cent. for male, thus equalizing to an extent the proportionate benefits.

THE NEW YORK LAW.

FREE PUBLIC EMPLOYMENT BUREAUS.

SECTION 40. Free public employment bureaus in cities of the first class. — The Commissioner of Labor Statistics shall organize and establish in all cities of the first class a free public employment bureau, for the purpose of receiving applications of persons seeking employment, and applications of persons seeking to employ labor. No compensation or fee shall be charged or received, directly or indirectly, from persons applying for employment or help through any such bureau. Such commissioner shall appoint for each bureau so organized, and may remove for good and sufficient cause, a superintendent and such clerical assistants as, in his judgment, may be necessary for the proper administration of the affairs thereof. The salaries of such superintendents and clerks shall be fixed by the commissioner. Such salaries and the expenses of such bureaus shall be paid in the same manner as other expenses of the Bureau of Labor Statistics.

SEC. 41. Duties of superintendent. — The superintendent of each free public employment bureau shall receive and record, in a book to be kept for that purpose, the names of all persons applying for employment or for help, designating opposite the name and address of each applicant, the character of employment or help desired.

Each such superintendent shall report, on Thursday of each week, to the commissioner of labor statistics, the names and addresses of all persons applying for employment or help, during the preceding week, the character of the employment or help desired, and the names of the persons receiving employment through his bureau. Such superintendent shall also perform such other duties in the collection of labor statistics, and in the keeping of books and accounts of his bureau, as the commissioner may require, and shall report semi-annually to the commissioner of labor statistics the expense of maintaining his bureau.

SEC. 42. Applications; list of applicants. — Every application for em-

ployment or help made to a free public employment bureau shall be void after thirty days from its receipt, unless renewed by the applicant.

The commissioner of labor statistics shall cause two copies of a list of all applicants for employment or help, and the character of the employment or help desired, received by him from each free public employment bureau, to be mailed on Monday of each week to the superintendent of each bureau, one of which copies shall be posted by the superintendent, immediately on receipt thereof, in a conspicuous place in his office, subject to the inspection of all persons desiring employment or help, and the other shall be filed in his office for reference.

SEC. 43. Applicants for help; when to notify superintendent. — If an applicant for help has secured the same, he shall, within ten days thereafter, notify the superintendent of the bureau, to which application therefor was made. Such notice shall contain the name and last preceding address of the employes received through such bureau. If any such applicant neglects to so notify such superintendent, he shall be barred from all future rights and privileges of such employment bureau, at the discretion of the commissioner of labor statistics, to whom the superintendent shall report such neglect.

OPERATIONS OF THE LAW IN NEW YORK CITY.

Through the courtesy of Mr. John J. Bealin, superintendent of the Free Public Employment Office at 30 West 29th Street, New York City, the Bureau is enabled to place before the readers of this report a complete description as to the manner in which the business of the office is conducted. Applicants for employment are furnished with a blank form for registration which they are required to fill out; this form being filed with the superintendent.

State of New York,
Bureau of Statistics of Labor,
(Free Public Employment Office.)

Registered No..... Date,.....
Name,..... Address,.....
Nationality,..... Age,..... Married or single?.....
No. of children,..... No. of dependent children,.....
Occupation,..... Kind of work desired,.....
Name and address of last employer,.....
Rate of wages received from last employer,.....
How long idle?..... How long employed at last place?.....
How long a resident of this State?..... Cause of idleness,.....
Are you willing to work outside city?..... Read or write?.....
Remarks, ...
.....
.....
(Signature.).....

NOTE. — The bureau does not warrant to find you employment. If it can place your labor you will be notified by postal card.

Registration for employment having been completed and filed, the superintendent immediately forwards to the person named in the application as "last employer" the following confidential inquiry concerning the applicant's character and competency.

State of New York,
Bureau of Statistics of Labor, Capitol, Albany, N. Y.
Free Employment Bureau, 30 West 29th St., New York City.

Confidential. Kindly Fill Out and Return. No.....

.....

.....

We take the liberty to ask you what you know as to the character and ability of ....., who states that ..... was employed by you as .....

How long was ..... in your employment?.....

Was ..... competent?.....

Was ..... sober and honest?.....

Was ..... willing and obliging?.....

You will readily recognize the advantage it will be to the general public that the above questions be answered by you. All communications of this kind are strictly confidential.

This bureau is conducted by the state of New York, and is free to employer and employe. There is no need of being in want of help or paying to procure such when you can have your orders filled here promptly. All classes of male and female help are on hand. Domestics are in waiting from nine to two o'clock. The office is open from nine A. M. to five P. M., except on Saturdays, when it is closed at noon.

Out of town orders should state precisely the class of help wanted, giving us notice in advance of visit to the office. A personal call at the office gives better satisfaction to employers.

Trusting you will have the kindness to answer the above inquiries as soon as possible, I am,

Truly yours,

.....

Superintendent.

Upon the receipt by the superintendent of the Bureau of satisfactory answers to the above, the applicant is informed that he or she will be notified immediately, when a situation such as has been applied for has been secured. The form of such notification is printed on a postal card, and is as follows:

State of New York,
Bureau of Labor Statistics,
Free Public Employment Office,
30 West 29th Street.
New York.....189..

M.....

Please call here immediately.

....., Superintendent.

Bring this card with you.

A position having been secured through the efforts of the Bureau, the employer is required to fill out the following blank form which is filed with the superintendent:

New York State Free Employment Bureau.

..... has this
..... day of ....., 189 , employed through this bureau,
....., whose last preceding address was
....., as .....at $.....

Thus it will be seen that a complete record, in detail, is always at hand for reference concerning every person who has secured employment through the efforts of the office, the name and address of the employer also being placed on file.

RESULT OF OPERATION.

This Bureau is indebted to Superintendent Bealin of the New York Free Public Employment Bureau for the following statement of the workings and operation of the office under his charge during the year ending December 31, 1898:

The general public is gradually beginning to understand the character and work of this bureau. At first we suffered from the belief among many that we were in some way connected with the charitable and correctional institutions of this state, and were engaged principally in securing employment for the discharged inmates of such institutions. Every day new patrons ask us "Who is it that controls this office, and how is it that there are no fees or charges? What class of servants do you get?" A careful and intelligent answer is given to all such inquiries, and in order that the bureau may be placed in its proper light before the public we prepared the following circular, which was mailed to employers and handed to our patrons in the office:

We take the liberty to call your attention to the free employment bureau, feeling that we can be of service to you as you are in the habit of employing help. This bureau is conducted by the state of New York and is free to employer and employe. There is no need of being in want of help or paying to procure such when you can have your orders filled here promptly. All classes of male and female help are on hand. Domestic servants are in waiting from nine until two o'clock. The office hours are from 9 A. M. to 5 P. M., except on Saturdays, when the office is closed at noon. Out of town orders should state precisely the class of help desired, giving us notice in advance of visit to the office. A personal call at the office gives better satisfaction to employers. All references are investigated.

Copies of this circular were mailed during the spring and summer

months to the numerous summer hotels and boarding-houses, where we secured employment for many people.

Each day attention was given to the advertisements for help in the various daily papers, and notice of the work of the bureau was sent to those employers whose orders we believed we could fill. We also sent the following letter to many servants who advertised for employment, when we had vacancies in their particular line of work:

New York State Free Employment Bureau,
30 West 29th Street.

Seeing your advertisement in to-day's paper, we desire to call your attention to the New York State free employment bureau. There are no charges made at this office, and servants with good references can always secure situations. The hours for waiting are from nine until two o'clock. If you would like to register your name and address here, call in the morning and bring your references.

Employers who visit us now understand that we are able to give them better satisfaction than they can get elsewhere, as we have no desire to place a person unless that person is qualified for the position.

On the other hand, applicants for employment find that in making use of this bureau for the placing of their labor that they are not lowering their dignity nor losing character, but are simply making use of a state labor exchange. From the inception of this bureau the equality of the employer and employe has been maintained. The employer desires to purchase labor, the employe has labor to sell, and both contribute equally through the public tax for the maintenance of this office, consequently their equality is a matter of right.

The fears of some people that this bureau would be taken advantage of by unworthy parties is not borne out by our experience, as the investigation of the applicant's reference and the record made with present employes demonstrates beyond a doubt.

While every effort is made to get employment for applicants, yet care is taken not to create an opinion that employes should be discharged because their places can be filled with ease. In this matter we observe a position of strict neutrality, having no desire to make a record at the expense of the employer or employe.

While giving attention to women who seek an outlet for their work, we also, to the best of our ability, and as far as our small accommodations permitted, kept in view the claims of men who filed their application for labor with us.

From time to time we sent our circulars to employers, calling their attention to the fact that we had on our registry all classes of male help, such as hall boys, elevator men, engineers, firemen, farm laborers, factory employes, store and office employes, etc.

So far as manual labor on public improvements in New York city is concerned, we find that the market is not free, and that to get a day's work as a common laborer one has to have a "pull" of some kind. A

letter from an alderman will place a man as an everyday laborer, while it would take a letter from a state senator to get a position as a watchman.

The moral effect of this bureau on the intelligence agencies of this city has been to force many of them to now advertise that they "supply help free to employers." Nevertheless, from time to time, complaints have reached us of unfair treatment from people who have paid fees in these offices to secure employment. In order to eradicate such practices, I would recommend that the power to grant and revoke licenses for intelligence agencies be vested in the commissioner.

During the year ending December 31, 1898, 5,100 persons registered for employment. Of these, 2,487 were men, and 2,613 were women.

Following the custom of the bureau, as each person filed his or her application, a circular letter was sent to the last employer, making inquiry as to the character and ability of such person, and asking for information that would give us a knowledge of the applicant's fitness to fill the position desired. This we do in order that we may have as full a knowledge as possible of our applicants for employment before we introduce them to employers. The replies received from former employers were, with few exceptions, such as warranted us in recommending our applicants to those needing their services.

Of the 2,487 men, 1,526 were foreigners, and 961 were Americans. Seven hundred and eighty-six men were married, 275 of which number reported having 691 children, 520 of them dependent for support.

Of the 2,613 women registered, 1,941 were foreigners, and 672 were Americans. One hundred and forty-two women reported having 235 children, of which 164 were dependent on them for support.

While 3,467 are registered as foreigners, yet their residence in the United States is of such duration as to warrant us in saying the greater number of them are Americans in all things save accident of birth.

Of the 2,487 men who registered for employment, 2,475 could read and write, while only 12 were illiterate. Of the 2,613 women, 2,364 could read and write and 249 were illiterate. The total number who could read and write is 4,839 and the illiterates 261.

Of the 261 illiterates who were tabulated, but a very small percentage of them were under 40 years of age, making it evident that the young people, so far as education is considered, have but little to complain of, whether foreign or Americans. And, although the 261 are tabulated as illiterates, we find that they possess average intelligence, and in their various avocations meet all that is required of them.

Our table of the "Duration of Idleness" shows a falling off in the percentage when compared to that of 1897. This condition can be attributed to the revival of business, yet there is room and need for improvement in this particular, as very many worthy people are still unemployed.

There is a change gradually taking place in the re-adjustment of domestic servants to meet present conditions. This change, for the present at least, is not very agreeable to women who have accustomed themselves to any one particular branch of such service. Owing to the large num-

bers of families desiring to reside in flats and apartment houses, demands for women who do general housework is on the increase, while calls for waitresses, chambermaids, cooks, etc., correspondingly decrease. We find it impossible to get girls to fill all our calls for general housework, as women who heretofore were employed at other branches of domestic service are very reluctant to make the change. For as cooks, chambermaids, and waitresses they say that they have regular hours, while as general houseworkers, they contend that their labor is hardly ever at an end, and many of the women are physically unable to perform the more laborious tasks of general housework.

Reports received from employers whom we have supplied with help are of a most pleasing character, going to show that their employes give satisfaction. While, on the other hand, but few complaints have been received from employes, and in each case, a communication from this office adjusted the difficulty.

While our present location is much more central and our offices more commodious than our original offices, yet we find that we are very much cramped for room. Our waiting-room is much too small and the need of a larger one is urgent. At present we are not able to accommodate the women whom we desire to have wait and meet employers, and at no time were we able to offer any such accommodation to men, simply because of lack of seating capacity. In order to meet the requirements of this bureau, it is necessary that we should have separate waiting-rooms for men and women, where proper ventilation can be had, and a larger room for the accommodation of employers.

During the year 1898 there were 302 applications for men, and 2,344 for women, an increase of 594 over the year ending December 31, 1897.

For the year 1898 we placed 39.6 per cent. of our applicants for employment, as against 20 per cent. for 1897 and 5.5 for the five months of 1896.

That the benefits of free public employment offices are appreciated, and that the movement is not retrograding, and once started will become a permanancy, is shown by the following extract taken from the Bulletin of the Bureau of Labor Statistics of the State of New York, issued September, 1899:

In proportion as the existence of the New York State free employment bureau has become known to our citizens its utility and work have increased. The necessity for such a bureau is made evident by the fact that the board of aldermen, at the request of a body of ladies interested in the matter, has passed a resolution to consider the advisability of reconstructing the licensing of employment agencies in New York city. This was brought about mainly by the fact that a woman employed by Mrs. Clarke at one of the intelligence agencies of this city was the dupe of a designing party, and was introduced into the Clarke family for the purpose of stealing the child in order to recover a ransom. At the office there was no record kept of the woman's antecedents or of her former employer.

The ladies who asked the board of aldermen to move in the matter of a more strict scrutiny on the part of the authorities over the intelligence offices demand that a special licensing bureau be created which shall compel proprietors of intelligence offices to keep a record of the name and address of each applicant for work and the name and address of the last employer, and to conduct the bureau somewhat after the system inaugurated by our bureau.

The abuses complained of as to the dishonesty displayed in the conduct of many such employment agencies still exist. A New York paper calling attention to this fact spoke of them recently as being dishonest; and, being so firmly convinced of this fact, it has laid down as a rule governing its advertising policy that no intelligence agency shall be advertised in its columns. Complaints have been repeatedly made at our bureau of the manner in which intelligence agencies are conducted. One particular instance was the case of two boys who paid their last dollar to secure a place as farmhands in New Jersey. Upon arriving at their destination they were told that there was no such employment for them, nor had a request been made at the office for such. The boys, being without money, anticipating instant employment and being disappointed, had to return to the city on foot.

It is a constant practice for girls who register at such places to be sent to supposed employers, only to find, upon reaching their journey's end, that they have been imposed upon. The New York State free employment bureau has thrown every safeguard around the interests of both employer and employe. We have insisted, in cases where help is wanted in the country, that the railroad fare shall be paid to the destination, and that the employer shall meet the employe to conduct her to the place of employment at the other end. On the other hand, we have insisted that all applicants who desire to have their labor placed shall keep any appointment made, and any one failing to do so forfeits the use of this office. Every effort has been made to ascertain the qualifications of applicants for the work sought. Letters asking for information from former employers as to the character and ability of the applicants have been very much to the credit of the people who seek to place their labor with us. As to the people for whom we have found employment, few complaints have been made, indeed, as to their ability and qualifications, and in but two cases was the complaint made by the employe that wages were not paid as per agreement, and a letter from this office to the employer has been successful in righting any such wrongs.

A reference to the table published herewith shows an increase in the number of applicants for work, applicants for help, and situations secured for the quarter ending June 30, 1899, as compared with the corresponding quarter of June 30, 1898. During the quarter ending June 30, 1898, we had 984 applications for help, placed 746, leaving 238 places that we were not able to fill. These were mainly applications for girls as general housework, the demand for such being far in excess of the supply at our command.

The state free employment bureau is located at 30 West Twenty-ninth Street, New York city. Applicants for help are in attendance from 9 o'clock until 2 P. M., with the exception of Saturday, when the office closes at noon. Office hours from 9 to 5, with the exception of Saturday, closing at noon.

Following is a statement by the Free Public Employment Bureau of the number of applicants for employment, number of applicants for help, and number of situations secured during the three months ending June 30, 1898 and 1899:

	Applicants for work.	Applicants for help.	Situations secured.
Quarter ending June 30, 1899,	1,381	984	746
Quarter ending June 30, 1898,	1,330	644	493

Per cent. of increase of situations secured, 51.

THE LAW OF MISSOURI.

Be it enacted by the General Assembly of the State of Missouri, as follows:

SECTION 1. The commissioner of labor statistics shall organize and establish in all the cities of Missouri containing one hundred thousand inhabitants or more, a free public employment bureau, for the purpose of receiving applications of persons seeking employment and the applications of persons seeking to employ labor. No compensation or fee shall be charged or received, directly or indirectly, from persons applying for employment or help through any such bureau. Such commissioner shall appoint for each bureau one superintendent, and may appoint for each one clerk, and may remove the same for good and sufficient cause. The salary of the superintendent shall not exceed one hundred dollars per month, and the salary of the clerks shall not exceed seventy-five dollars per month. Such salaries and expenses of such bureaus shall be paid in the same manner as the other expenses of the bureau of labor statistics.

SEC. 2. The superintendent of each free employment bureau shall receive and record, in a book kept for that purpose, the names of all persons applying for employment or for help, designating opposite the name and address of each applicant the character of employment or help desired. Such superintendent shall perform such other duties in the collection of labor statistics and in keeping of books and accounts of his bureau as the commissioner may require, and shall report monthly to the labor commissioner the expenses of maintaining his bureau.

SEC. 3. Every application for employment or help made to a free public employment bureau shall be void after thirty days from its receipt, un-

less renewed by the applicant. If an applicant for help has secured the same, he shall, within ten days thereafter, notify the superintendent of the bureau to which application was therefor made. Such notice shall contain the name and last preceding address of the employes received through such bureau. If any such applicant neglects to notify such superintendent he shall be barred from all future rights and privileges of such employment bureau, at the discretion of the commissioner of labor statistics, to whom the superintendents shall report such neglect.

SEC. 4. The urgent demand for the immediate application of the provisions of this act is such as to create an emergency within the meaning of the constitution; therefore, this act shall take effect and be in force from and after its passage.

Approved, May 23, 1899.

OPERATION OF THE LAW IN MISSOURI.

The following extract is taken from the report of the Missouri Commissioner of the Bureau of Labor Statistics, and covers the operation of the Free Employment Department of the state for the year ending October 1, 1898:

The Missouri free employment department was inaugurated in connection with the Bureau of Labor October 1, 1897. While the idea of employment offices supported and controlled by the State is comparatively new, it has been tried in several states, notably New York, Ohio, Nebraska, and Montana, and generally proven worthy of public confidence and legislative support.

To the State of Ohio is due the credit of having established the first free employment office. Such offices have long been in successful operation in several of the European countries, but, so far as we can ascertain, the "Ohio idea" was without precedent in the United States.

As heretofore stated, the free employment office in this state was opened in 1897 in connection with the office of the state factory inspector, 915-916 Chemical building, St. Louis, Mo.

Owing to the failure of the St. Louis authorities to appoint a factory inspector, as provided by law, it was felt that the state inspector was not justified in giving all of his time to St. Louis, to the exclusion of other cities, hence the necessity of turning the office to practical account suggested the free employment agency in connection with the other work of the department, without extra expense to the state. Practically the same force employed in the inspector's office has conducted the work in the free employment department.

With a slight increase in the office force much better results would have been obtained. At no time were more than three persons employed, and much of the time only two, including the superintendent.

While no legislative authority was sought prior to the inauguration of the system, the matter was communicated to the Governor, who endorsed the plan, since which being put in operation, has been warmly espoused by

the press and public. It is gratifying indeed that not one single protest has been made anywhere throughout the state against the operation of this department, but, on the contrary, words of commendation and praise come from every quarter, from the employers and employes alike.

The bringing together of the employer in need of help and the worthy unemployed seeking work, free of expense to both and at a minimum cost, is the chief function of the state employment office. The state itself cannot furnish employment, and the class who patronize this department so understand.

In establishing the free employment system in Missouri, without a special appropriation for that purpose, it was necessary to exercise the closest economy, and to that end the most simple and effective business methods were adopted.

All applicants, whether for help or employment, are required to use a blank furnished by the department, which, after being properly filled out, is returned to the office by mail or in person, and the name, address, etc., of the applicant is there registered for thirty days. All applications are canceled after the expiration of thirty days, but those not finding employment may renew their applications every thirty days until employment is secured.

FORM OF APPLICATION FOR EMPLOYMENT.

State of Missouri,
Bureau of Labor Statistics,
Thomas P. Rixey, Com'r.

Registration hours: 8 A. M. to 12 M.

Classification.....

Free Employment Department,
835 Century Building,
St. Louis.

Application for Employment.

App. No..... Date.....
Name..... Address.....
Nationality..... Married or single..... Age.....
No. of dependent children.....
Occupation..... Kind of work desired.....
Name and address of last employer.....
How long idle..... How long employed in last place.....
How long a resident of this state..... Cause of idleness.....
Wages desired.....
Can you read and write.....
Remarks.....
.....
.....
References..... Signature.....
P. O.....Mo.....
Street No.....

NOTE.—The Bureau does not warrant to find you employment. If it can place your labor you will be notified by postal card. No application for employment will be registered where references are omitted. All applications expire after thirty days. Renewals may be made every thirty days until employment is secured. Address all applications to 835 Century Building, St. Louis, Mo.

Form of Application to Applicants where Service is Wanted.

(Card.)

State of Missouri,
Bureau of Labor Statistics.

Registration hours: 8 A. M. to 12 M.

Free Employment Department,
835 Century Building.

St. Louis,..... 189..

M.....
apply to.....
.....
For position.....
Present this card and notify us if employment is secured.

Superintendent.

Form of Application for Help.

State of Missouri,
Bureau of Labor Statistics.

Registration hours: 8 A. M. to 12 M.

Classification.....

Free Employment Department,
835 Century Building,
St. Louis.

Application for Help.

App. No..... .....189..

Superintendent State Free Employment Department:
I am in need of the services of.....
.....
Remarks.....
.....
Wages.....
Notice.—Persons desiring help are required to furnish postage for notifying applicants.

Name.....
Street.....
City.....Mo.

Form of Notification to Applicants where Help is Found.

(Card.)

State of Missouri,
Bureau of Labor Statistics.

Registration hours: 8 A. M. to 12 M.

Free Employment Department,
835 Century Building.

St. Louis,..... 189..

M.....
.....
Your application for.....
received at this office and placed on record. We have notified.....
to call on you. When supplied, kindly notify us of the fact immediately.

Very respectfully,

These are the only blanks used in the office, and there are but two registers; one for employers and another for those desiring employment. Sample pages from these registers are herewith submitted:

HEADING IN REGISTER FOR EMPLOYES.

State of Missouri, Bureau of Labor. EMPLOYES' REGISTER. *Free Employment Department. Established 1897.*

Number.	Date.	Name.	Address.	Nationality.	Married or single.	Age.	Sex.	No. children dependent.	Position desired.	Last employer.	Length time employed.	Cause of idleness.	Wages desired.	References.	Disposal.
....	....	.....	.....	....	....	....	....	....	.....	.....	....	.....	....	....	....
....	....	.....	.....	....	....	....	....	....	.....	.....	....	.....	....	....	....
....	....	.....	.....	....	....	....	....	....	.....	.....	....	.....	....	....	....
....	....	.....	.....	....	....	....	....	....	.....	.....	....	.....	....	....	....

HEADING IN REGISTER FOR EMPLOYERS.

State of Missouri, Bureau of Labor. EMPLOYERS' REGISTER. *Free Employment Department. Established 1897.*

Number.	Date.	Name.	Address.	Help desired.	Married or single.	Sex.	Remarks.	Disposal.
....	.....	.....	.....	.....	.....	.....	.....	.....
....	.....	.....	.....	.....	.....	.....	.....	.....
....	.....	.....	.....	.....	.....	.....	.....	.....
....	.....	.....	.....	.....	.....	.....	.....	.....

Applications for help and employment are classified and recorded under different headings, representing the various kinds of labor in such a manner that it requires only a moment to ascertain the name, qualification, or standing of an applicant.

It will be observed that the method of registration and communication between the two classes is as convenient and simple as it is possible to devise.

The work is carried on without the slightest friction, and very few mistakes have been made in placing applications for positions, considering the large number registered. Not all those who apply for work can be provided for, but no favoritism is shown. The one who is best qualified for certain positions and produces the most satisfactory recommendations or reference, as a rule, is the one chosen to fill the position. In most cases the employer makes his own selection from several applicants.

Considering the limited time the Missouri free employment office has been in operation (one year), and the further fact that the work has been done with the regular appropriation for the Bureau of Labor and Inspection, the record is one to be proud of. No other free employment office in the United States can show as great a per cent. of positions secured for applicants as ours.

The orders for help received and filled from October 1, 1897, to October 1, 1898, inclusive, are as follows:

APPLICATIONS FOR HELP FILLED.

Miscellaneous	144	Janitors, porters, and watchmen	20
Seamstresses and dressmakers	89	Laborers (miscellaneous)	573
Bakers	16	Laundresses and laundrymen	76
Cooks and helpers	280	Mechanics	166
Carpenters	41	Nurses	89
Collectors	17	Printing trades	25
Drivers and teamsters	89	Office help and boys	142
Dairymen	14	Professional	31
Farm help	167	Private place	57
Factory help (miscellaneous)	11	Solicitors and salesmen	1,064
Governesses, companions, teachers	19	Stenographers	82
House help	1,344		
Hotel and restaurant help	105	Total	4,661

Under the head of "professional" are advance agent for lecturer, portrait painter, civil engineer, physicians, newspaper men, druggists, female druggists, lawyers, teacher of clay modeling, specialists in Belle Lettres History, etc., photo artist, promoter, and piano player.

Under "mechanics" are wagon-makers, cobblers, carriage blacksmiths, plasterers, bricklayers, smokestack painters, butchers, barbers, brass and iron-moulders, blacksmith, and horse-shoers, bridge and structural iron-workers, carriage painters, shoe fitters, upholsterers, shoemakers, matchers and ripsaw men, engineers, firemen, tinners, granite cutters, hoisting engineers, electrical engineers, machinists, brass finishers, metal polishers, core-makers, plumbers, gas fitters, wood-working machine hands, marble cutters, sign writers, paperhangers, cabinet makers, bench molders, sheet-iron workers, tailors.

Miscellaneous orders include vinegar pickle men, men with covered wagons, soap makers, meat cutters, prospectors, auctioneers, clay pit men, description writers, candy-makers, tobacco stemmers, dyers and cleaners, educated women for drapery departments, experts on tobacco growing, girls for leather work, manicurists, hoop-pole shavers, curbstone setters, stone sawyers, machine draughtmen, armature winders, men to operate steam drills, bicycle repairers, steam hammer men, photographers, telegraphers, bottlers, box-nailers, granitoid workers, single-tree makers, and vise-makers.

NUMBER AND CLASSIFICATION REGISTERED.

Bricklayers	15	Hotel, restaurant help—male.	108
Blacksmiths and horse-shoers	108	Hotel, restaurant help—female	131
Brewers	17	Laundry workers — female...	34
Bakers	49	Miscellaneous mechanics.....	394
Butchers	22	Nurses — female.....	136
Barbers	4	Office help—male.....	749
Cooks and helpers — male....	146	Office help—female.....	92
Cooks and helpers — female..	157	Boys	362
Collectors	107	Porters and watchmen.....	479
Coachmen	22	Printers and print trades.....	54
Carpenters	154	Professional	132
Cigar-maker	1	Private place (general work).	171
Dairymen	19	Stenographers — male.....	108
Drug clerks	10	Stenographers — female.....	292
Seamstresses and milliners...	163	Salesmen and solicitors—male	548
Engineers and firemen.....	216	Saleswomen and female solicitors	51
Electrical workers	37	Teamsters and drivers.....	278
Farm help	242	Teachers — male.....	12
Laborers	908	Teachers and companion—female	52
Grocery clerks	151		
Gardeners	34		
House help — female.....	1,018		
		Total	7,783

Total number females registered	2,103
Total number males registered	5,680
Total	7,783

Orders have been received from the following states and countries: Illinois, Arkansas, Tennessee, Kansas, Texas, New Mexico, Alabama, Louisiana, Indian Territory, Kentucky, Georgia, Indiana, Mississippi, Iowa, Oklahoma Territory, Ohio, Nebraska, Old Mexico, and Montana.

Not the least service rendered the public by the establishment of the state free employment department has been the decimation of the fraudulent "employment agencies," so called, especially in St. Louis, where sixteen of these concerns were said to exist only a year ago, only four are now to be found.

The methods of these concerns in trapping the unwary are almost beyond belief, but the daily complaints to the officers of the law confirm their truthfulness. A careful investigation of these fraudulent agencies was made by this department last year, and the following extract from the nineteenth annual report is reproduced:

Not all of the employment agencies can be classed as fraudulent, but in the investigations made by this department in St. Louis alone a large majority of them were found to outrival in their methods the worst gambling and confidence games in the city, yet their systems of robbery were so cunningly devised and so skillfully operated that it is almost impossible to convict them under the existing law.

During the investigation 2,000 contracts for applications for employment made with two agencies for a period of six months were secured. However, the two concerns were practically one; the business being conducted by the same parties. But, owing to the numerous charges of

fraud, a change of name was necessary in order to deceive the applicant for employment and secure patronage.

The 2,000 applications represent an income to the agency of about $3,000 for each six months, or $6,000 per year, of which the unemployed of St. Louis were defrauded by one company alone. This $6,000 is clear profit on an investment limited to the cost of a desk and a few chairs.

The following is a copy of the form of contract used by these concerns:

St. Louis,....., 189..

This agreement, made and entered into by and between the ..... Employment Co. and ....., applicant, both of St. Louis, Mo., wherein the said applicant seeks information relative to a position as ..... or other work of a similar nature, under the following terms and conditions:

1st. That all fees paid to said ..... Employment Co. in advance are paid for the express purposes of defraying all incidental expenses in procuring information with reference to the position desired and for services to be rendered by the said ..... Employment Co. in various ways.

2d. It is further agreed and understood that the said ..... Employment Co. shall have ....., if necessary, in which to furnish said applicant employment, and that no money will be refunded and no position guaranteed.

3d. It is also agreed and understood that in event of the said ..... Employment Co. procuring said applicant employment, said applicant agrees to pay said ..... Employment Co. 10 per cent. of the amount of the first month's salary arising from such employment.

Witness our hand and seal this ..... day of ....., 189..

Applicant represents the following:

Age.....years.
Nationality..... Language spoken.....
Business formerly engaged in.....References.....
..... Employment Co...
....., Applicant.
....., Address.

From the above it will be seen that the company promises to do absolutely nothing for the fee charged. Verbally, however, all sorts of promises are made and inducements offered. The victim is told that signing this agreement is a mere matter of form, and the 10 per cent. clause is pointed out and dilated upon to show that from motives of self-interest alone the employment company is bound to procure work for the applicant. When the work is not forthcoming within a reasonable time, and the applicant becomes dissatisfied, his contract is produced and he is told to read it for his own edification.

The fees charged are on the sliding scale system, limited only to the size of the applicant's purse, and range anywhere from 50 cents to $10.

In order to determine just what percentage of applicants received employment through these agencies, 70 names were selected from the number of applications in possession of the department, and a communication was addressed each one requesting information on this point. Of the 47 answers received, not one had secured employment through any aid given by these agencies.

Under the existing law it is almost impossible to secure a conviction.

The law grants the agency reasonable time within which to procure the applicant employment, and the prosecuting attorney construes this to mean 30 days. The majority of persons who apply to these agencies are from the country; their means are limited, and they cannot remain in the city without work for any great length of time. As a result, they are never on hand to prosecute. If by chance they succeed in finding work in the interim they cannot afford to lose the time or their situation by being absent from employment, when they in any event remain the losers.

With the exception of possibly two private concerns, the employment agencies in the city of St. Louis are conducted by a class of persons who have no business outside the walls of the penitentiary.

They prey upon the class who can least afford to lose, even though it be but a small amount. As a rule, the greater the need the easier the victim.

To give a semblance of honesty to the business, an arrangement is frequently made with some business concern (which is not above turning a dishonest penny) to tell the applicant that the "place has just been filled;" the consideration being a part of the fee paid the agency. This scheme was disclosed by reputable employers to whom the proposition had been made.

The state free employment system has not only been endorsed by the leading labor organizations, but it is heartily approved by all classes.

Any public institution to be honest in its work and permanent in its usefulness must be the result of a demand of and by the people. Many alleged "public institutions" not having this "reason for being" either are wisely obliterated or are maintained but to furnish sinecures for political dependents. No public problem presses more for answer to-day than "What shall we do with the unemployed?"

As long as human nature remains at its present level there will be the willfully idle, but to classify with such the great host of honest men and women who would gladly work is to not only prove oneself unjust, but grossly ignorant of existing economic and social conditions. Constant improvement in machinery, overcrowding towards the centers of population, the forcing of women and children into positions formerly occupied by men, but most of all, a contradicted currency, have caused great numbers of honest and capable men and women to be without work. In being deprived of this right to work, the right to "life, liberty, and the pursuit of happiness" so proudly guaranteed him by our constitution, he is denied the inalienable right of every American citizen. To restore him that right is but to uphold our national fabric.

On the other hand, it is believed that in many instances the employers suffer from having to retain incapable or insolent labor when the very man needed was to be had, could he but be communicated with. The genuineness of any demand made simultaneously by capital (as represented by the manufacturer, merchant, *et al.*) and by labor should not be questioned. Hence the necessity of legalizing the free employment system by the state and placing it on a footing where it can render still greater service to the public.

In concluding this portion of the report it should be stated that, besides the four states mentioned as having free employment agencies in active and successful operation, there are other states in which the necessity for the creation of free offices of this kind has been made apparent, and in which the sentiment for their inception has been aroused to such an extent as to cause legislation to that end.

It has been the purpose of the Bureau, in treating this subject, to bring before the reader of the report a synopsis of the operation of the plan in those states in which the obtaining conditions are somewhat similar to those prevailing in Connecticut; therefore, brief mention only will be made concerning the laws which have been enacted in other states, not hereinbefore referred to.

In the city of Seattle, State of Washington, a free employment bureau was established in 1893, and, concerning the success of the experiment, the commissioner in charge says:

> During the time that the public employment office has been in existence it has been of incalculable value in bringing together employers and employes to the number of many thousands, and has saved in cash to the laboring classes fully $25,000.

In the State of Montana free employment agencies have been in operation, although the commissioner of that State says:

> Owing to the rapid development of the wonderful mineral and other resources of the state the need of such agencies was not felt.

In California there has never been a free employment agency directly authorized or provided for by legislation, but, however, during the financial depression of 1894-1897, the labor commissioner of that State inaugurated a system similar in effect to those in operation elsewhere, which was maintained in most part by private contribution. The commissioner writes under date of November 10, 1899:

> Employers are now looking for labor, rather than *vice versa*.

In conclusion, while it is not the purpose of the Bureau to advise or suggest legislation concerning any subject, yet it would seem that the opportunity and time have arrived when a law should be enacted, which, in effect, would place the care and supervision of the unemployed in the hands of a State department.

Part IV

Connecticut Labor Organizations

1 CLASSIFIED

2 BY TOWNS

3 TRADES

4 LOCATION

5 OFFICERS

6 POST-OFFICE ADDRESSES

CONNECTICUT LABOR ORGANIZATIONS.

It has been deemed expedient by the bureau to publish in this report a correct and complete schedule and record of the labor organizations of the state, and, with this end in view, schedules were prepared and circulated among those known to be officially connected with trade organizations. A work concerning this subject, of the magnitude contemplated, had never before been undertaken, and, although in most instances the schedules were returned filled out in proper form, yet there were many cases which required much correspondence, and indeed, personal visits of bureau representatives in order to secure the desired information. In this connection, it should be stated that the names of many officers are not published in this chapter of the report for the reason that personal requests were made, of the officials of the bureau, that they be withheld.

It must be apparent to every working man and woman that a work of this kind, containing as it does a complete directory of Connecticut labor organizations, cannot fail to be of inestimable value to the laboring classes, and surely comes under the meaning of the Statute concerning the duties of the Commissioner of the Bureau of Labor Statistics.*

Again, the record which follows is of value to the bureau, for it furnishes the names and post-office addresses of those individuals most interested in the subjects treated upon in the publi-

(Extracts from Statutes.)

*Section 2947. "The Commissioner shall collect information upon the subject of labor, its relation to capital, the hours of labor, and the earnings of laboring men and women, and the means of promoting their material, social, intellectual, and moral prosperity; but for this purpose, persons shall not be required to leave the vicinity of their residences or places of business."

cations issued from this office, thus making possible a more thorough and satisfactory distribution of the documents issued by the department.

Examination of the directory develops the fact that there are two hundrd and fourteen separate and distinct labor organizations in the state, sub-divided into fifty different trades or occupations and located in thirty-four several towns and cities.

Location being considered, the record shows that Hartford leads the state in number of separate labor organizations, there being thirty-three distinct associations, societies, orders, and lodges directly identified with the interests of organized labor whose headquarters and places of meeting are in that city. New Haven follows with twenty-four, Bridgeport having, within its borders, twenty-two.

There are fourteen separate organizations of iron moulders in the state; fourteen unions of metal polishers; eleven each of cigar-makers', carpenters', and brick-layers' unions; the machinist trades, typographical unions, and railroad trainmen organizations number eight each. The remaining number included in the tabulation are classified under various trades, there being a limited number in each.

LABOR ORGANIZATIONS CLASSIFIED BY TOWNS.

ANSONIA.

Cigar Makers Union, No. 103
Core Makers Union, No. 40.
Horse Shoers Union, No. 47.
Iron Moulders Union, No. 71.
Machinists Lodge, No. 362.
Musicians Union.
Stationary Engineers Association.

BETHEL.

Hat Finishers Association.
Hat Makers Association.
Hat Trimmers Union.

BRANFORD.

Iron Moulders Union, No. 82.
Metal Polishers Union, No. 122.

BRIDGEPORT.

Bakers Union, No. 38.
Bakers Union, "Independent."
Brick Layers Union, No. 2.
Carpenters Union, No. 115.
Central Labor Union.
Cigar Makers Union, No. 282.
Core Makers Union.
Elastic Goring Weavers Association.
Iron Moulders Union, No. 110.
Machinists Lodge, No. 30.
Machinists and Tool Makers Association.
Metal Polishers Union, No. 40.
Musical Protective Union.
Painters and Decorators Union.
Plumbers Union.
Railroad Trainmen's Lodge, No. 111.
Stationary Engineers Association.
Stone Masons Union, No. 4.
Tailors Union.
Theatrical Machanics Association.
Tinners and Sheet Metal Workers Union.
Typographical Union, No. 252.

BRISTOL.

Metal Polishers Union, No. 86.

DANBURY.

Bakers Union, No. 193.
Barbers Union, No. 175.
Beaver Assembly, K. of L., No. 2824.
Central Labor Union.
Cigar Makers Union, No. 180.
Hatters Assembly, K. of L., No. 7923.

DANBURY — *Continued.*

Hat Coners and Slippers Union.
Hat Finishers Association.
Hat Makers Association.
Hat Trimmers Union.
Hat Trimmers Assembly, K. of L., No. 494.
Italia Assembly, K. of L., No. 4236.
Locomotive Firemen's Lodge, No. 493.
Musicians Union.
Railroad Trainmen's Lodge, No. 332.
Shoe Makers Union.
Tailors Union.
Typographical Union.

DERBY.

Carpenters Union, No. 127.
Central Labor Union.
Machinists Lodge, No. 259.
Metal Polishers Union, No. 54.
Painters and Decorators, No. 99.
Plumbers Union, No. 132.

EAST HARTFORD.

Railroad Trainmen's Lodge, No. 551.

HARTFORD.

Bakers Union, No. 8.
Barbers Union, No. 73.
Blacksmiths Union, No. 107.
Book Binders Union, No. 15.
Brewers Union, No. 35.
Bricklayers Union, No. 1.
Building Laborers Union.
Carpenters Union, No. 43.
Central Labor Union.
Cigar Makers Union, No. 42.
Clerks Association.
Core Makers Union, No. 30.
Drivers Union, No. 14.
Electrical Workers Union, No. 37.
Horse Nail Workers Union, No. 6170.
Horse Shoers Union, No. 14.
Iron Moulders Union, No. 75.
Locomotive Engineers, Division No. 205.
Locomotive Firemen's Lodge, No. 285.
Machinists Association, No. 354.
Metal Polishers Union, No. 35.
Musicians Union.
Pattern Makers League.

HARTFORD — *Continued.*

Printing Trades Council.
Plumbers Union, No. 76.
Pressmen's Union, No. 75.
Railway Conductors Order, No. 50.
Railroad Trainmen's Lodge, No. 118.
Stationary Engineers, No. 5.
Stone Cutters Union, No. 1.
Stone Masons Union, No. 5.
Tinners and Sheet Metal Workers.
Typographical Union, No. 127.

LONG HILL.

Cigar Makers Union, No. 139.

MERIDEN.

Barbers Union, No. 88.
Brass Moulders Assembly, K. of L., No. 4934.
Brass Workers Union, No. 134.
Brass Workers and Polishers, No. 8.
Brewers Union, No. 5.
Bricklayers Union.
Central Labor Union.
Iron Moulders Union, No. 74.
Knife Grinders Union.
Metal Polishers Union, No. 23.
Musicians Union.
Plumbers Union.
Stationary Engineers Association, No. 1.
Street Railroad Employes Association.
Typographical Union, No. 314.

MIDDLETOWN.

Bricklayers Union, No. 11.

NIANTIC.

Granite Cutters Union.

NAUGATUCK.

Iron Moulders Union, No. 87.

NEW BRITAIN.

Bakers Union, No. 107.
Bricklayers Union, No. 3.
Building Laborers Union, No. 4.
Carpenters Union, No. 97.
Iron Moulders Union, No. 241.
Machinists Lodge, No. 436.
Metal Polishers Union, No. 126.
Painters and Decorators Union, No. 21.
Plumbers Union, No. 122.
Stationary Engineers Association.
Trades Council.

NEW HAVEN.

Bakers Union, No. 11.

NEW HAVEN — *Continued.*

Brewers Union, No. 37.
Bricklayers Union, No. 6.
Carpenters Union, No. 79.
Cigar Makers Union, No. 39.
Granite Cutters Union.
Electrical Workers Union.
Horse Shoers Union, No. 26.
Iron Moulders Union, No. 60.
Locomotive Firemen's Lodge, No. 284.
Locomotive Engineers, Division No. 77.
Machinists Lodge, No. 366.
Plumbers Union.
Pressmen's Union, No. 74.
Railroad Trainmen's Lodge, No. 201.
Railway Conductors Order.
Railway Conductors Independent Order.
Stationary Engineers Association.
Stone Masons Union, No. 7.
Tailors Union, No. 22.
Trades Council.
Typographical Union, No. 47.
Wood Carvers Association.

NEW LONDON.

Barbers Union, No. 136.
Bricklayers Union, No. 10.
Carpenters Union, No. 133.
Central Labor Union.
Cigar Makers Union, No. 189.
Granite Cutters Union.
Iron Moulders Union, No. 156.
Locomotive Engineers, Division No. 348.
Railroad Trainmen's Lodge, No. 496.
Typographical Union, No. 159.
Weavers Union.

NORWALK.

Bakers Union, No. 216.
Bricklayers Union.
Carpenters Union, No. 746.
Central Labor Union.
Elastic Goring Weavers Association.
Hat Finishers Association.
Hat Trimmers Association.
Iron Moulders Union, No. 209.
Stationary Engineers Association.

NORWICH.

Bricklayers Union, No. 12.
Carpenters Union, No. 137.
Central Labor Union.
Cigar Makers Union, No. 407.
Iron Moulders Union, No. 126.
Plumbers Union, No. 169.
Typographical Union, No. 100.

ROXBURY.
Granite Cutters.

SHELTON.
Knife Grinders Union.

SOUTH NORWALK.
Barbers Union, No. 72.
Cigar Makers Union, No. 26.
Hat Makers Association.
Musicians Union, No. 52.

STAMFORD.
Bricklayers Union, No. 8.
Carpenters Union, No. 210.
Iron Moulders Union, No. 161.
Metal Polishers Union, No. 92.
Railroad Trainmen's Lodge, No. 398.

STONY CREEK.
Granite Cutters.

SUFFIELD.
Cigar Makers Union, No. 156.

TAFTVILLE.
Loom Fixers Union.
Mule Spinners Union.

TARIFFVILLE.
Lace Curtain Operatives Society.

TORRINGTON.
Carpenters Union, No. 216.
Iron Moulders Union, No. 245.

TORRINGTON — *Continued.*
Metal Polishers Union, No. 104.
Painters and Decorators Union.

THOMPSONVILLE.
Metal Polishers Union, No. 72.

UNIONVILLE.
Knife Grinders Union.

WALLINGFORD.
Metal Polishers Union, No. 73.

WATERBURY.
Brewers Union, No. 126.
Bricklayers Union, No. 16.
Building Trades Council.
Carpenters Union, No. 260.
Cigar Makers Union, No. 395.
Clock Makers Union.
Granite Cutters Union.
Iron Moulders Union, No. 298.
Lathers Union.
Machinists Lodge, No. 349.
Metal Polishers Union, No. 37.
Metal Polishers Union, No. 120.
Plumbers Union, No. 22.
Railroad Trainmen's Lodge, No. 423.
Stationary Engineers Association, No. 597.
Typographical Union, No. 329.
United Trades Council.

WEST CORNWALL.
Metal Polishers Union, No. 96.

LABOR ORGANIZATIONS CLASSIFIED BY TRADES AND LOCATION.

American Federation of Labor, Office at Danbury.

BAKERS.

Bridgeport Local, No. 38.
Bridgeport "Independent."
Danbury.
Hartford.
New Britain.
New Haven.
Norwalk.

BARBERS.

Danbury.
Hartford.
Meriden.
New London.
South Norwalk.

BLACKSMITHS.

Hartford.

BOOK BINDERS.

Hartford.

BRASS WORKERS, NO. 8.

Meriden.

BRASS WORKERS, NO. 134.

Meriden.

BREWERS.

Hartford.
Meriden.
New Haven.
Waterbury.

BRICKLAYERS.

Bridgeport.
Hartford.
Meriden.
Middletown.
New Britain.
New Haven.
New London.
Norwalk.
Norwich.
Stamford.
Waterbury.

BUILDING LABORERS.

Hartford.
New Britain.

CARPENTERS.

Bridgeport.
Derby.

CARPENTERS — *Continued.*

Hartford.
New Britain.
New Haven.
New London.
Norwalk.
Norwich
Stamford.
Torrington.
Waterbury.

CENTRAL LABOR UNIONS.

Bridgeport.
Danbury.
Derby.
Hartford.
Meriden.
New London.
Norwalk.
Norwich.

CIGAR MAKERS.

Ansonia.
Bridgeport.
Danbury.
Hartford.
Long Hill.
New Haven.
New London.
Norwich.
South Norwalk.
Suffield.
Waterbury.

CLERKS.

Hartford.

CLOCK MAKERS.

Waterbury.

CORE MAKERS.

Ansonia.
Bridgeport.
Hartford.

ELECTRICAL WORKERS.

Hartford.
New Haven.

GRANITE CUTTERS.

New Haven.
New London.

GRANITE CUTTERS — *Continued.*
Niantic.
Roxbury.
Stony Creek.
Waterbury.

HAT CONERS AND SLIPPERS.
Danbury.

HAT FINISHERS.
Bethel.
Danbury.
Norwalk.

HAT MAKERS.
Bethel.
Danbury.
South Norwalk.

HAT TRIMMERS.
Bethel.
Danbury.
Norwalk.

HORSE NAIL WORKERS.
Hartford.

HORSE SHOERS.
Ansonia.
Hartford.
New Haven.

IRON MOULDERS.
Ansonia.
Branford.
Bridgeport.
Hartford.
Meriden.
Naugatuck.
New Britain.
New Haven.
New London.
Norwich.
South Norwalk.
Stamford.
Torrington.
Waterbury.

KNIFE GRINDERS.
Shelton.
Unionville.
Meriden.

KNIGHTS OF LABOR.
Danbury, No. 7923.
Danbury, No. 2824.
Danbury, No. 494.
Danbury, No. 4236.
Meriden, No. 4934.

LATHERS.
Waterbury.

LOCOMOTIVE ENGINEERS.
Hartford.
New Haven.
New London.

LOCOMOTIVE FIREMEN.
Danbury.
Hartford.
New Haven.

LOOM FIXERS.
Taftville.

MACHINISTS.
Ansonia.
Bridgeport.
Bridgeport "Independent."
Derby.
Hartford.
New Britain.
New Haven.
Waterbury.

METAL POLISHERS.
Branford.
Bridgeport.
Bristol.
Derby.
Hartford.
Meriden.
New Britain.
Stamford.
Thompsonville.
Torrington.
Wallingford.
Waterbury, No. 37.
Waterbury, No. 120.
West Cornwall.

MUSICIANS.
Ansonia.
Bridgeport.
Danbury.
Hartford.
Meriden.
Norwalk.

MULE SPINNERS.
Taftville.

PAINTERS AND DECORATORS.
Bridgeport.
Derby.
New Britain.
Torrington.

PATTERN MAKERS.
Hartford.

PLUMBERS.
Bridgeport.

PLUMBERS — *Continued.*
Derby.
Hartford.
Meriden.
New Britain.
New Haven.
Norwich.
Waterbury.

PRESSMEN.
Hartford.
New Haven.

RAILWAY CONDUCTORS.
Hartford.
New Haven.
New Haven "Independent."

RAILROAD TRAINMEN.
Bridgeport.
Danbury.
East Hartford.
Hartford.
New Haven.
New London.
Stamford.
Waterbury.

SHOE MAKERS.
Danbury.

STATIONARY ENGINEERS.
Ansonia.
Bridgeport.
Hartford.
Meriden.
New Britain.
New Haven.
Norwalk.
Waterbury.

STREET RAILWAY EMPLOYES.
Meriden.

STONE CUTTERS.
Hartford.

STONE MASONS.
Bridgeport.
Hartford.
New Haven.

TAILORS.
Bridgeport.
Danbury.
New Haven.

TEAM DRIVERS.
Hartford.

TINNERS.
Bridgeport.
Hartford.

THEATRICAL EMPLOYES.
Bridgeport.

TRADES COUNCIL.
Hartford, "Printing."
New Britain.
New Haven.
Waterbury, "Building."
Waterbury, "United."

TYPOGRAPHICAL.
Bridgeport.
Danbury.
Hartford.
Meriden.
New Haven.
New London.
Norwich.
Waterbury.

WEAVERS.
Bridgeport, "Elastic Goring."
New London.
Norwalk.
Tariffville.

WOOD CARVERS.
New Haven.

NAMES AND POST-OFFICE ADDRESSES OF OFFICERS OF LABOR ORGANIZATIONS.

AMERICAN FEDERATION OF LABOR, CONNECTICUT STATE BRANCH.

President — Eli Brunell, 180 High street, Hartford.
Vice-President — John J. O'Neil, 376 Olive street, Bridgeport.
Secretary-Treasurer — P. H. Connolley, 234 Main street, Danbury.
Organizer — James Goodacre, 12 Linden Place, Hartford.
Executive Council — Martin Lawler, Bethel; James Grierson, 110 East Broad street, Norwich.

BAKERS UNION, NO 38 — BRIDGEPORT.

President — John Winter, 162 Black Rock avenue, Bridgeport.
Financial Secretary — Albert Strauch, 155 Hamilton street, Bridgeport.
Recording Secretary — William Enery, 105 Helen street, Bridgeport.
Treasurer — John Rossner, 603 East Main street, Bridgeport.

BAKERS UNION, "INDEPENDENT" — BRIDGEPORT.

President — Jacob Karchar, 25½ Thompson street, Bridgeport.
Vice-President — Fritz Zipperer, 102 Goddard avenue, Bridgeport.
Financial Secretary — Charles Sachs, 99 Goddard avenue, Bridgeport.
Recording Secretary — Joseph Kaussler, Jane street, Bridgeport.
Treasurer — Christian Strohle, Pembroke street, Bridgeport.

BAKERS UNION, NO. 193 — DANBURY.

President — Henry Koch, 268 Main street, Danbury.
Financial Secretary — Michael Oechsner, Danbury.
Recording Secretary — John J. Johnson, 268 Main street, Danbury.
Treasurer — Thomas Coughlin, Danbury.

BAKERS UNION, NO. 8 — HARTFORD.

President — Frederick Zepp, 17 Garvan street, East Hartford.
Financial Secretary — Henry Kuehn, 72 Temple street, Hartford.
Recording Secretary — Paul Kubler, 48 Avon street, Hartford.
Treasurer — Paul Schmidt, 13 Morris street, Hartford.

BAKERS UNION, NO. 107 — NEW BRITAIN AND BRISTOL.

President — Gustav V. Hausen, Bristol.
Secretary — Emil Eisenhardt, 52 Central street, New Britain.
Treasurer — J. R. Hess, Plainville.

BAKERS UNION, NO. 11 — NEW HAVEN.

Secretary — George Swenson, 611 Grand avenue, New Haven.
Treasurer — John Schumacher, 1298 State street, New Haven.

BAKERS UNION, NO. 216 — NORWALK.

President — Robert McIlveene, 44 Van Zant avenue, East Norwalk.
Vice-President — Paul Preusser, 11 High street, Norwalk.
Financial Secretary — Horace Edmunds, 14 Lewis street, Norwalk.
Recording Secretary — John Sullivan, 47 Belden avenue, Norwalk.
Treasurer — Patrick Carberry, 19 Main street, Norwalk.

BARBERS UNION, NO. 175 — DANBURY.

President — Paul Roth, 13 Elm street, Danbury.
Financial Secretary — Ed. Epper, P. O. Box C, Danbury.
Recording Secretary — Fred Pingpank, 7 White street, Danbury.
Treasurer — E. B. Loop, 55 Elm street, Danbury.

BARBERS UNION, NO. 73 — HARTFORD.

President — Frederick Gauthier, 27 Pearl street, Hartford.
Vice-President — Fred W. Davis, 3 Asylum street, Hartford.
Financial Secretary — James V. Burns, 158 Asylum street, Hartford.
Recording Secretary — R. C. A. Laugzettel, 27 Pearl street, Hartford.
Treasurer — Frederick A. Kilby, 22 State street, Hartford.

BARBERS UNION, NO. 88 — MERIDEN.

President — Frank Perez, 897 Colony street, Meriden.
Secretary — J. C. Corbly, 53 Liberty street, Meriden.
Treasurer — W. Walker, 115 Cook avenue, Meriden.

BARBERS UNION, NO. 136 — NEW LONDON.

President — Frank Saunders, Jr., 3 North Main street, New London.
Vice-President — James F. Barber, 14 Garfield avenue, New London.
Financial Secretary — George Goss, 85 Huntington street, New London.
Recording Secretary — Thomas A. Rogers, 3 Commercial street, New London.
Treasurer — William P. De Hotman, 37 Crystal avenue, East New London.

BARBERS UNION, NO. 72 — SOUTH NORWALK.

President — Otto Linstrom, 66 Washington street, South Norwalk.
Secretary — Frank V. Zahn, 153 Washington street, South Norwalk.
Treasurer — Oscar Fischer, 38 South Main street, South Norwalk.

BOOK BINDERS UNION, NO. 15 — HARTFORD.

President — Severin Wilson, 17 Buckingham street, Hartford.
Vice-President — Henry A. Simms, 26 Lenox place, Hartford.
Secretary — John Coughlan, 239 Jefferson street, Hartford.
Treasurer — Frederick Flinn, 10 Franklin avenue, Hartford.

BRICKLAYERS UNION, NO. 2 — BRIDGEPORT.

President — Henry Cullen, 61 Ann street, Bridgeport.
Vice-President — Thomas Burnes, 478 Ivanistan avenue, Bridgeport.
Secretary — Daniel McPadden, 73 Steuben street, Bridgeport.
Treasurer — David O'Rurke, 179 Union avenue, Bridgeport.

BRICKLAYERS UNION, NO. 1 — HARTFORD.

President — Michael A. Foley, 7 Hamilton street, Hartford.
Financial Secretary — George W. Butler, 241 Park street, Hartford.
Corresponding Secretary — John J. McQuillan, 110 Ward street, Hartford.
Treasurer — John F. Coniff, 63 Ward street, Hartford.

BRICKLAYERS UNION, NO. 11 — MIDDLETOWN.

President — B. W. Butler, 287 College street, Middletown.
Financial Secretary — M. T. Walsh, Elm street, Middletown.
Corresponding Secretary — S. G. Ratcliffe, 161 Prospect street, Middletown.
Treasurer — Maurice Kinnery, Flower street, Middletown.

BRICKLAYERS UNION — MERIDEN.

President — B. A. Robinson, 284 Crown street, Meriden.
Vice-President — John Clancey, 202 Grove street, Meriden.
Secretary — R. F. Morrissey, 276 Center street, Meriden.
Treasurer — John Ryan, 299 Grove street, Meriden.

BRICKLAYERS UNION, NO. 3 — NEW BRITAIN.

President — Walter Kingsbury, 185 So. Stanley street, New Britain.
Secretary — Joseph P. Quinn, 16 Star street, New Britain.
Treasurer — Albert Rivers, 76 Clark street, New Britain.

BRICKLAYERS UNION, NO. 12 — NORWICH.

President — Frank Carroll, 17 Peck street, Norwich.
Financial Secretary — John O'Brien, 155 Cliff street, Norwich.
Corresponding Secretary — A. E. Cruthers, 10 Hill street, Norwich.
Treasurer — Ambrose Sullivan, 294 Laurel Hill, Norwich.

BRICKLAYERS UNION, NO. 6 — NEW HAVEN.

President — Edward F. Rehberg, 179 Rosette street, New Haven.
Vice-President — William Dorman, 171 Ivy street, New Haven.
Financial Secretary — John F. Wright, 106 Washington street, New Haven.
Corresponding Secretary — Joseph F. O'Brien, 231 Franklin street, New Haven.
Treasurer — Michael F. White, 64 Asylum street, New Haven.

BRICKLAYERS UNION, NO. 10 — NEW LONDON.

President — F. T. McCoy, 8 Central avenue, New London.
Vice-President — Francis Delmore, 22 Shaw street, New London.
Financial Secretary — Thomas Fowler, 265 Ocean avenue, New London.
Recording Secretary — James W. Fox, Vauxhall street, New London.
Treasurer — Wellington Lamb, 3 Willets avenue, New London.

BRICKLAYERS UNION — NORWALK.

President — Richard Seymour, Rowayton.
Vice-President — George W. Fitch, 2 Maple street, Norwalk.
Secretary — Ferdinand Wardwell, 2 Livingston place, South Norwalk.
Treasurer — Walter Hoyt, 6 Fitch street, East Norwalk.

BRICKLAYERS UNION, NO. 8 — STAMFORD.

President — Michael Daly, 10 Pacific street, Stamford.
Secretary — James Sutton, 23 Garden street, Stamford.
Treasurer — Theodore Pembleton, 13½ Hoyt street, Stamford.

BRICKLAYERS UNION, NO. 16 — WATERBURY.

President — Donald McKenzie, 16 Pratt place, Waterbury.
Vice-President — Richard Walker, 16 Chapel street, Waterbury.
Financial Secretary — John White, 6 Eastern avenue, Waterbury.
Corresponding Secretary — William Forrest, 685 South Main street, Waterbury.
Treasurer — J. R. Leggett, 133 Division street, Waterbury.

BREWERS UNION, NO. 35 — HARTFORD.

President — August Werrotenscky, 315 Park street, Hartford.
Financial Secretary — Frank Sarvi, 36 Canton street, Hartford.
Recording Secretary — Frederick Lechner, 217 Windsor street, Hartford.
Treasurer — John Feulner, 315 Park street, Hartford.

BREWERS UNION, NO. 5 — MERIDEN.

President — George Robb, 255 South Colony street, Meriden.
Secretary — Joseph P. Casey, 210 Pratt street, Meriden.
Treasurer — Martin Nill, 254 South Colony street, Meriden.

BREWERS UNION, NO. 37 — NEW HAVEN.

President — William Miller, 14 Ferry street, New Haven.
Financial Secretary — Max Tromler, 8 Arch street, New Haven.
Recording Secretary — Henry Kossbiel, P. O. Box 36, Allington.
Treasurer — August Firich, 4 Poplar street, New Haven.

BREWERS UNION, NO. 126 — WATERBURY.

President — Joseph Schmidt, 6 Third street, Waterbury.
Secretary — John King, 14 Third street, Waterbury.
Treasurer — Herman Gartz, 64 Clark street, Waterbury.

BLACKSMITHS UNION, NO. 117 — HARTFORD.

President — Richard J. Phillips, 43 Grand street, Hartford.
Financial Secretary — Henry Sawyer, 27 Affleck street, Hartford.
Recording Secretary — Thomas McCall, 30 Putnam street, Hartford.
Treasurer — Samuel Peterson, 46 Laurel street, Hartford.

BRASS WORKERS UNION, NO. 8 — MERIDEN.

President — John Kane, 18 Russell street, Meriden.
Secretary — James E. Hannagan, 29 North First street, Meriden.
Treasurer — Herman Gritz, Graveline avenue, Meriden.

BRASS WORKERS UNION, NO. 134 — MERIDEN.

President — Clark Andrews, 29 Colony street, Meriden.
Secretary — Joseph Underwood, 96 Woodland street, Meriden.
Treasurer — Leopold Danegan, 12 South First street, Meriden.

BUILDING LABORERS UNION — HARTFORD.

President — James Moriarty, 18 Dean street, Hartford.
Vice-President — James Hamston, 35 So. Prospect street, Hartford.
Secretary — Thomas Godfrey, 19 Howard street, Hartford.
Treasurer — Thomas Martin, 4 Donald street, Hartford.

BUILDING LABORERS UNION, NO. 4 — NEW BRITAIN.

President — John Cotter, 27 Lee street, New Britain.
Secretary — William J. Gray, 33 Lee street, New Britain.
Treasurer — Michael Higgins, 43 West Pearl street, New Britain.

CARPENTERS UNION, NO. 115 — BRIDGEPORT.

President — William P. Russell, 691 Brooks street, Bridgeport.
Financial Secretary — Augustus Mullen, 72 Williams street, Bridgeport.
Recording Secretary — George L'Hommedieu, 205 State street, Bridgeport.
Treasurer — George B. Foley, 772 Howard avenue, Bridgeport.

CARPENTERS UNION, NO. 127 — DERBY.

President — George A. Lewis, 235 Main street, Derby.
Secretary — Robert Scholley, 176 Division avenue, Derby.
Treasurer — George H. Lamperg, 36 Bank street, Derby.

CARPENTERS UNION, NO. 43 — HARTFORD.

President — Andrew McKirdy, 102 Seymour street, Hartford.
Financial Secretary — Alexander Mackay, 33 Julius street, Hartford.
Recording Secretary — George E. Miskill, 237 Lawrence street, Hartford.
Treasurer — James R. Cairns, 158 Clark street, Hartford.

CARPENTERS UNION, NO. 97 — NEW BRITAIN.

President — Samuel L. Whaples, 41 So. Burritt street, New Britain.
Vice-President — Edward H. Crosley, Kensington.
Secretary — Emerson V. Moore, 15 Pine street, New Britain.
Treasurer — Albert A. Fuller, 311 Chestnut street, New Britain.

CARPENTERS UNION, NO. 79 — NEW HAVEN.

President — Charles W. Mordecai, 26 Starr street, New Haven.
Financial Secretary — William Wilson, 508 Chapel street, New Haven.
Recording Secretary — Thomas Harris, 246 Dixwell avenue, New Haven.
Treasurer — Albert E. Ellis, 487 Elm street, New Haven.

CARPENTERS UNION, NO. 133 — NEW LONDON.

President — George W. Arnold, Terrace avenue, East New London.
Financial Secretary — Andrew J. Keeney, 7 Wall street, New London.
Recording Secretary — Elias P. Smith, 46 Lewis lane, New London.
Treasurer — George C. Williams, 812 Bank street.

CARPENTERS UNION, NO. 746 — NORWALK.

President — William A. Pryor, 10 Springhill street, Norwalk.
Financial Secretary — William A. Kellogg, 162 Belden avenue, Norwalk.
Recording Secretary — A. Greenwood, 17 Riverside avenue, Norwalk.
Treasurer — E. E. Masters, 9 Orchard street, Norwalk.

CARPENTERS UNION, NO. 137 — NORWICH.

President — John T. Sullivan, 249 Prospect street, Norwich.
Vice-President — Louis Andrews, 16 Cliff street, Norwich.
Financial Secretary — F. S. Edmonds, 293 Central avenue, Norwich.
Recording Secretary — James Grierson, 110 East Broad street, Norwich.
Treasurer — Alvin D. Lewis, 94 Asylum street, Norwich.

CARPENTERS UNION, NO. 210 — STAMFORD.

President — J. F. Flynn, 8 West Broad street, Stamford.
Financial Secretary — R. B. McMullen, 176 Pacific street, Stamford.
Recording Secretary — R. D. Black, 9 William street, Stamford.
Treasurer — J. R. Daniels, 41 Henry street, Stamford.

CARPENTERS UNION, NO. 216, TORRINGTON.

President — N. C. Ramsey, 405 Prospect street, Torrington.
Financial Secretary — D. H. Treadwell, No. 2 Allen block, East Main street, Torrington.
Recording Secretary — Fred C. Tripp, 3 Travis street, Torrington.
Treasurer — Fred A. Barber, 351 South Main street, Torrington.

CARPENTERS UNION, NO. 260 — WATERBURY.

President — Niles J. Elglekee, 3 Cook street, Waterbury.
Financial Secretary — Joseph E. Sandiford, 27 North Vine street, Waterbury.
Treasurer — James McCluerey, 13 North Vine street, Waterbury.

CENTRAL LABOR UNION — BRIDGEPORT.

President — John Daley, 15 California avenue, Bridgeport.
Secretary — John J. O'Neil, 376 Olive street, Bridgeport.
Treasurer — William Russell, 94 Stratford avenue, Bridgeport.

CENTRAL LABOR UNION — DANBURY.

President — John H. Riley, 13 James street, Danbury.
Secretary — Edwin Daniels, 136 South street, Danbury.
Treasurer — George Washington Scott, 5 North Lincoln avenue, Danbury.

CENTRAL LABOR UNION — DERBY.

President — Thomas Horan, 20 Cherry street, Derby.
Secretary — Robert Scholley, 176 Division avenue, Derby.
Treasurer — Matthew Whalen, 545 Howe avenue, Derby.

CENTRAL LABOR UNION — HARTFORD.

President — John J. Doyle, 121 Mather street, Hartford.
Financial Secretary — M. J. Brown, 148 Albany avenue, Hartford.
Corresponding Secretary — D. A. Fitzpatrick, 128 Ann street, Hartford.
Treasurer — George B. Bradford, 231 Bellevue street, Hartford.

CENTRAL LABOR UNION — MERIDEN.

President — Fred N. Habersang, 1 North First street, Meriden.
Vice-President — Daniel Daniels, 25 Grove street, Meriden.
Secretary — J. C. Corbly, 53 Liberty street, Meriden.
Treasurer — Henry Cline, 55 Merriam street, Meriden.

CENTRAL LABOR UNION — NEW LONDON.

President — George Goss, 85 Huntington street, New London.
Vice-President — Thomas A. Rogers, 3 Commercial street, New London.
Secretary — Samuel Rosenthal, 85 State street, New London.
Treasurer — William G. De Hotman, 15 Bank street, New London.

CENTRAL LABOR UNION — NORWALK.

President — Thomas Casey, 70 North Main street, South Norwalk.
Secretary — George P. Hands, 35 Belden avenue, Norwalk.
Treasurer — James W. Duffy, 33 Cross street, Norwalk.

CENTRAL LABOR UNION — NORWICH.

President — Elected at each meeting.
Secretary — William S. Robb, 47 Thames street, Norwich.
Treasurer — John T. Hinchey, 106 Oakridge street, Norwich.

CIGAR MAKERS UNION, NO. 103 — ANSONIA.

President — William E. Lasch, 20 Clifton avenue, Ansonia.
Secretary — John Zeigler, 18 Clifton avenue, Ansonia.
Treasurer — Frank B. Martinez, 112 Beaver street, Ansonia.

CIGAR MAKERS UNION, NO. 282 — BRIDGEPORT.

President — Charles Doerner, 626 Main street, Bridgeport.
Financial Secretary — George C. Ott, 313 Water street, Bridgeport.
Recording Secretary — E. Fredrickson, 8 Green street, Bridgeport.
Treasurer — George Englehard, 172 Hallam street, Bridgeport.

CIGAR MAKERS UNION, NO. 180 — DANBURY.

President — Joseph Hirt, 110 Elm street, Danbury.
Vice-President — Lewis Kuhn, Dalys lane, Danbury.
Secretary — John H. Riley, P. O. Box 68, Danbury.
Treasurer — Philip J. Hossann, 4 Mallory street, Danbury.

CIGAR MAKERS UNION, NO. 42 — HARTFORD.

President — James L. McMannis, 270 Main street, Hartford.
Secretary — William J. Dolan, 98 Retreat avenue, Hartford.
Treasurer — A. M. Chapman, 91 Asylum street, Hartford.

CIGAR MAKERS UNION, NO. 139 — LONG HILL.

President — H. A. Jobes, Long Hill.
Secretary and Treasurer — William A. Gabler, Long Hill.

CIGAR MAKERS UNION, NO. 39 — NEW HAVEN.

President — Frank W. Johnson, 90 Pearl street, New Haven.
Financial Secretary — Meyer Stodel, 245 Washington avenue, New Haven.
Recording Secretary — Philip Band, 75 Ashmun street, New Haven.
Treasurer — M. Belasco, 72 York street, New Haven.

CIGAR MAKERS UNION, NO. 189 — NEW LONDON.

President — James J. Dooley, 17 Starr street, New London.
Secretary — C. E. Bergquist, 26 West Coit street, New London.

CIGAR MAKERS UNION, NO. 407 — NORWICH.

President — Frank H. Tetreault, 8 Broadway, Norwich.
Secretary — Charles F. A. Thurber, 449 North Main street, Norwich.
Treasurer — John T. Hinchey, 106 Oakridge street, Norwich.

CIGAR MAKERS UNION, NO. 26 — SOUTH NORWALK.

President — Wilfred W. Morrison, 2 Hanford place, East Norwalk.
Vice-President — Nicholas Martin, 4 Summer street, Norwalk.
Corresponding Secretary — Walter T. Taylor, 7 Mott avenue, Norwalk.
Recording Secretary — William J. Schlitt, 23 Franklin street, South Norwalk.
Treasurer — Bernard J. Reynolds, 21 Haviland street, South Norwalk.

CIGAR MAKERS UNION, NO. 156 — SUFFIELD.

President — John D. Kurvin, P. O. Box 16, Suffield.
Secretary — John Trapnell, P. O. Box 26, Suffield.
Treasurer — L. N. Lipps, P. O. Box 87, Suffield.

CIGAR MAKERS UNION, NO. 395 — WATERBURY.

President — Chris Bieri, 12 Exchange place, Waterbury.
Financial Secretary — J. F. Lawler, 156 South Main street, Waterbury.
Recording Secretary — Walter Crossland, 220 Cherry street, Waterbury.
Treasurer — E. D. Morgan, 766 East Main street, Waterbury.

CLERKS PROTECTIVE ASSOCIATION, HARTFORD.

President — S. J. Blake, 39 Spring street, Hartford.
Secretary — R. P. Grant, Jr., 76 Trumbull street, Hartford.
Treasurer — C. S. Jacobs, 1305 Main street, Hartford.

CLOCK MAKERS UNION — WATERBURY.

Names of officers withheld.

CORE MAKERS UNION, NO. 40 — ANSONIA.

President — James T. Walters, 197 Howard avenue, Ansonia.
Vice-President — F. Loescher, 222 Prospect street, Ansonia.
Financial Secretary — W. C. Lugg, 30 Arch street, Ansonia.
Corresponding Secretary — H. Heppner, 36 Oliva street, Derby.
Treasurer — Charles Krist, 98 Grove street, Derby.

CORE MAKERS UNION, NO. 49 — BRIDGEPORT.

President — Oscar Schell, 98 Austin street, Bridgeport.
Secretary — Timothy Shehan, 295 North Washington avenue, Bridgeport.
Treasurer — James Ryan, 737 Seaview avenue, Bridgeport.

CORE MAKERS UNION, NO. 30 — HARTFORD.

President — John P. Callahan, 156 Bellevue street, Hartford.
Vice-President — John B. Conway, 86 Putnam street, Hartford.
Secretary — Edward J. McDonough, 623 Capitol avenue, Hartford.
Treasurer — Peter De Mars, 7 Riverside street, Hartford.

ELECTRICAL WORKERS UNION, NO. 37 — HARTFORD.

President — Maurice Sullivan, 177 Asylum street, Hartford.
Vice-President — Frank Kernan, Poquonock.
Secretary — John J. Tracy, 58 Temple street, Hartford.
Treasurer — Thomas F. Herbert, 3 Central row, Hartford.

ELECTRICAL WORKERS UNION — NEW HAVEN.

Organized December 12, 1899.

GRANITE CUTTERS UNION — NEW HAVEN.

President — Robert C. Roach, 90 Cedar Hill avenue, New Haven.
Secretary — William M. Pote, 20 View street, New Haven.
Treasurer — William Flannigan, 26 White street, New Haven.

GRANITE CUTTERS UNION — NEW LONDON.

President — John M. Geary, 38 Blackhall street, New London.
Vice-President — Dennis Callahan, 77 Walback street, New London.
Secretary — Albert A. Daniels, Groton.
Treasurer — Ludwic Stotz, Cemetery road, New London.

GRANITE CUTTERS UNION — NIANTIC.

President — John Jenkins, Niantic.
Financial Secretary — John Buckingham, Niantic.
Recording Secretary — William J. Walker, P. O. Box 75, Niantic.
Treasurer — George Rook, Niantic.

GRANITE CUTTERS UNION — ROXBURY.

Secretary — D. W. Holmes, Roxbury.

GRANITE CUTTERS UNION — STONY CREEK.

President — Alfred Adams, P. O. Box 66, Stony Creek.
Financial Secretary — Charles Collins, Stony Creek.
Recording Secretary — Alexander Malley, P. O. Box 78, Stony Creek.
Treasurer — William G. Rogers, Stony Creek.

GRANITE CUTTERS UNION — WATERBURY.

President — John Grady, 68 Fuller street, Waterbury.
Vice-President — William Vail, 64 East Dover street, Waterbury.
Secretary and Treasurer — James M. Skahan, 2 Carrollton place, Waterbury.

HAT CONERS AND SLIPPERS UNION — DANBURY.

President — Walter Meyers, Hulls Hill, Danbury.
Secretary — Edgar V. Warren, 21 Orchard street, Danbury.
Treasurer — James H. Shelley, Bethel.

HAT FINISHERS ASSOCIATION — BETHEL.

President — George W. Morehouse, Bethel.
Vice-President — Charles M. Baisley, Bethel.
Secretary — William P. Bailey, Bethel.
Treasurer — Howard S. Gilbert, Bethel.

HAT FINISHERS ASSOCIATION — DANBURY.

President — Charles J. Barrett, 119 Liberty street, Danbury.
Vice-President — Henry F. May, 31 Center street, Danbury.
Secretary — H. C. Shalvoy, 117 Main street, Danbury.
Treasurer — William Humphries, 9 Stevens street, Danbury.

HAT FINISHERS ASSOCIATION — NORWALK.

President — Joseph Tammany, Jr., 14 Monroe street, South Norwalk.
Vice-President — Charles Lynch, 3 Tolles street, South Norwalk.
Secretary — John W. Sculley, 14 Monroe street, South Norwalk.
Treasurer — S. H. Carlin, 10 Day street, South Norwalk.

HAT MAKERS ASSOCIATION — BETHEL.

President — Charles O. Lathrop, Bethel.
Secretary — Martin Lawler, Bethel.
Treasurer — John McDowell, Bethel.

HAT MAKERS ASSOCIATION — DANBURY.

President — James P. Maher, 46 Town Hill avenue, Danbury.
Vice-President — Henry Lepper, 23 Griffing avenue, Danbury.
Secretary — P. H. Connolley, 234 Main street, Danbury.
Treasurer — Albert B. Hoyt, 11 West street, Danbury.

HAT MAKERS ASSOCIATION — SOUTH NORWALK.

President — Charles A. Bradley, 2 Grove street, South Norwalk.
Vice-President — William A. Brennan, 29 Woodward street, South Norwalk.
Secretary — Michael J. Golden, 2 Grove street, South Norwalk.
Treasurer — Homer Rockwell, 13 Chestnut street, South Norwalk.

HAT TRIMMERS UNION — BETHEL.

President — Miss Phebe Benedict, Bethel.
Vice-President — Mrs. J. Russell, Bethel.
Secretary — Mrs. E. Treadwell, Bethel.
Treasurer — Miss Henrietta Shepard, Bethel.

HAT TRIMMERS UNION — DANBURY.

President — Mrs. Ellen Foote, Broadview Farm, Danbury.
Vice-President — Miss Julia Moore, 51 Sheridan street, Danbury.
Secretary — Miss Katie E. Smith, 47 Town Hill avenue, Danbury.
Treasurer — Miss Lizzie Weldon, Newtown.

HAT TRIMMERS UNION — NORWALK.

President — Miss Charlotte Temple, 8 Henry street, East Norwalk.
Secretary — Miss Emma F. Buxton, 24 Elizabeth street, South Norwalk.
Treasurer — Miss Annie Burr, 31 Franklin street, South Norwalk.

HORSE NAIL WORKERS UNION — HARTFORD.

President — Frank Tracy, 19 Chapel street, Hartford.
Vice-President — William C. Rungee, 10 Wyllys street, Hartford.
Corresponding Secretary — Edwin Booth, 22½ Alden street, Hartford.
Financial Secretary — Frank Weatherbee, 228 Franklin avenue, Hartford.
Recording Secretary — William J. Welsh, 10 Wadsworth street, Hartford.
Treasurer — Hubbard N. Ventress, 28 Governor street, Hartford.

HORSE SHOERS UNION, NO. 87 — ANSONIA.

President — M. F. Donohue, 35 Bassett street, Ansonia.
Secretary — James A. Conners, 270 Main street, Ansonia.
Treasurer — John Coughlin, 16 Bridge street, Ansonia.

HORSE SHOERS UNION, NO. 14 — HARTFORD.

President — John H. Carey, 22 South Prospect street, Hartford.
Secretary — James T. Heffernan, 26 Kingsley street, Hartford.
Treasurer — Patrick Connors, 27 Wells street, Hartford.

HORSE SHOERS UNION, NO. 26 — NEW HAVEN.

President — Cornelius Dineen, 267 James street, New Haven.
Vice-President — Mark Sullivan, 72 Minor street, New Haven.
Secretary — W. E. Heiser, 107 Liberty street, New Haven.
Treasurer — A. J. Laventure, 133 Ashmun street, New Haven.

IRON MOULDERS UNION, NO. 71 — ANSONIA.

President — Robert Adamson, 44 High street, Ansonia.
Secretary — J. J. Widdowfield, 27 Arch street, Ansonia.
Treasurer — Benjamin Jenkins, 101 Beaver street, Ansonia.

IRON MOULDERS UNION, NO. 82 — BRANFORD.

Names of officers withheld.

IRON MOULDERS UNION, NO. 110 — BRIDGEPORT.

President — William T. Roe, 473 William street, Bridgeport.
Financial Secretary — William Medcalf, 585 Hallett street, Bridgeport.
Secretary — Matthew Daly, 106 Hanover street, Bridgeport.
Treasurer — Charles Knox, 1182 Pembroke street, Bridgeport.

IRON MOULDERS UNION, NO. 75 — HARTFORD.

Names of officers withheld.

IRON MOULDERS UNION, NO. 74 — MERIDEN.

President — O. G. Hauschildt, 91 Linsley avenue, Meriden.
Corresponding Secretary — M. P. Mead, 160 Mount Pleasant street, Meriden.
Financial Secretary — P. H. Costello, 230 Grove street, Meriden.
Treasurer — James Meade, 177 Mount Pleasant street, Meriden.

IRON MOULDERS UNION, NO. 87 — NAUGATUCK.

Names of officers withheld.

IRON MOULDERS UNION, NO. 241 — NEW BRITAIN.

Names of officers withheld.

IRON MOULDERS UNION, NO. 60 — NEW HAVEN.

Names of officers withheld.

IRON MOULDERS UNION, NO. 156 — NEW LONDON.

President — George Gomez, 15 Pequot avenue, New London.
Vice-President — Frank Speelman, Walback street, New London.
Corresponding Secretary — Charles Hickey, 130 Shaw street, New London.
Financial Secretary — Francis I. Corcoran, 4 Orchard street, New London.
Recording Secretary — Edward Tinker, Waterford.
Treasurer — Daniel P. Beebe, 124 Shaw street, New London.

IRON MOULDERS UNION, NO. 126 — NORWICH.

President — Daniel Donovan, 204 Franklin street, Norwich.
Corresponding Secretary — M. S. Burns, 64 Washington street, Norwich.
Financial Secretary — Robert Mahoney, 20 Ward street, Norwich.
Recording Secretary — John W. Shea, 13 Thames street, Norwich.

IRON MOULDERS UNION, NO. 209 — NORWALK.

President — John E. Howard, 16 High street, Norwalk.
Secretary — W. C. Conley, 32 Center avenue, Norwalk.
Treasurer — John Henry, 8 Leonard street, Norwalk.

IRON MOULDERS UNION, NO. 161 — STAMFORD.

President — James Durnin, Foundry street, Stamford.
Corresponding Secretary — John O'Toole, Foundry street, Stamford.
Financial Secretary — M. J. Mooney, Jefferson street, Stamford.
Treasurer — Conrad Lund, Springdale.

IRON MOULDERS UNION, NO. 245 — TORRINGTON.

President — William E. Phelan, 307 South Main street, Torrington.
Vice-President — John Ryan, Scoville street, Torrington.
Financial Secretary — Thomas Hillary, Lewis street, Torrington.
Recording Secretary — Alfred Neile, South Main street, Torrington.
Treasurer — Peter O'Hara, Jackson street, Torrington.

IRON MOULDERS UNION, NO. 298 — WATERBURY.

Names of officers withheld.

KNIFE GRINDERS UNION — SHELTON.

President — Albert Mills, Shelton.
Secretary — William Hall, Shelton.
Treasurer — Walter Frost, Shelton.

KNIFE GRINDERS UNION, NO. 5 — UNIONVILLE.

President — Adam Lance, Unionville.
Secretary — Frank Glynn, Unionville.
Treasurer — Samuel Dowan, Unionville.

KNIFE GRINDERS UNION — MERIDEN.

President — James Hall, South Meriden.
Secretary — Phillip Mills, South Meriden.
Treasurer — Arthur Caton, South Meriden.

KNIGHTS OF LABOR, "HATTERS ASSEMBLY," No. 7923 — DANBURY.

Master Workman — Martin Gorman, Danbury.
Secretary and Treasurer — Elijah Morris, 76 West Wooster street, Danbury.

KNIGHTS OF LABOR, "BEAVER ASSEMBLY," NO. 2824 — DANBURY.

Master Workman — Thomas H. Turner, 9 Center street, Danbury.
Treasurer — Edwin Daniels, 136 South street, Danbury.
Worthy Foreman — John H. Lahey, 413 Main street, Danbury.
Worthy Inspector — William H. Hitchcock, 14 Liberty street, Danbury.

KNIGHTS OF LABOR, "HAT TRIMMERS ASSEMBLY," NO. 494 — DANBURY.

President — Miss Lizzie McDonald, Town Hill avenue, Danbury.
Secretary — Mrs. E. E. Heath, Danbury.
Treasurer — Mrs. Wardwell, Danbury.

KNIGHTS OF LABOR, "ITALIA ASSEMBLY," NO. 4236 — DANBURY.

President — Celestino Gaio, Griffin avenue, Danbury.
Secretary — Celestino Popolo, 16 George street, Danbury.
Treasurer — Giacanio Zerbolo, 37 Griffin avenue, Danbury.

KNIGHTS OF LABOR, "BRASS MOULDERS" — MERIDEN.

Master Workman — Charles Levens, Meriden.
Secretary — Edward O'Neil, 106 Franklin street, Meriden.
Treasurer — Thomas McCarthy, 140 Foster street, Meriden.

LATHERS UNION, NO. 1 — WATERBURY.

President — James Rankin, 8 Burton street, Waterbury.
Secretary — James Dolan, 144 East Main street, Waterbury.
Treasurer — Phillip Duphiney, 25 West Farm street, Waterbury.

LOCOMOTIVE ENGINEERS, DIVISION NO. 205 — HARTFORD.

President — Silas N. Smith, 152 Mather street, Hartford.
Secretary — C. H. Blake, 14 Linden street, East Hartford.
Insurance Secretary — Charles Wiley, 34 Balmforth avenue, Danbury.
Treasurer — P. M. Giddings, 21 Linden street, East Hartford.

LOCOMOTIVE ENGINEERS, DIVISION NO. 77 — NEW HAVEN.

Chief Engineer — George B. Close, 166 Howard avenue, New Haven.
Second Engineer — William Alling, 82 Spring street, New Haven.
First Assistant Engineer — George H. Witherell, 80 First street, New Haven.
Second Assistant Engineer — S. P. Rand, 374 Crown street, New Haven.

LOCOMOTIVE ENGINEERS, DIVISION NO. 348 — NEW LONDON.

President — George H. Rich, 41 Harrison street, New London.
Secretary — Charles T. Decker, 13 Pleasant street, New London.
Treasurer — H. D. Hathaway, 19 Twelfth street, New London.

LOCOMOTIVE FIREMEN'S LODGE, NO. 493 — DANBURY.

President — William M. Horan, 3 Balmforth avenue, Danbury.
Secretary — William N. Andrews, 111 Main street, Danbury.
Treasurer — Seth Shove, 14 Bennett street, Danbury.
Collector — Fred Branzhaf, 321 Main street, Danbury.

LOCOMOTIVE FIREMEN'S LODGE, NO. 285 — HARTFORD.

President — H. H. Caldwell, 60 Walnut street, Hartford.
Secretary — B. C. Bowne, P. O. Box 10, Burnside.
Treasurer — L. W. Smith, 146 Albany avenue, Hartford.

LOCOMOTIVE FIREMEN'S LODGE, NO. 284 — NEW HAVEN.

President — C. E. Lowell, 158 Spring street, New Haven.
Secretary — J. F. Farrell, 38 Putnam street, New Haven.
Collector — F. F. Clark, 221 Kimberley avenue, New Haven.

LOOM FIXERS UNION — TAFTVILLE.

President — Christome Caron, 15 North B street, Taftville.
Secretary — Joseph H. Caron, Taftville.
Treasurer — John Crossley, 13 Providence street, Taftville.

MACHINISTS ASSOCIATION, NO. 362 — ANSONIA.

President — John W. Kelley, 183 Clifton avenue, Ansonia.
Secretary — Charles Eastop, 28 Arch street, Ansonia.
Treasurer — Archibald Davison, 151 North State street, Ansonia.

MACHINISTS ASSOCIATION, NO. 30 — BRIDGEPORT.

President — Daniel Blydenburgh, 2 Pierpont street, Bridgeport.
Secretary — Peter Dahlgard, 714 Maple street, Bridgeport.
Treasurer — Richard Schulze, 10 Clifford street, Bridgeport.

MACHINISTS AND TOOLMAKERS ASSOCIATION — BRIDGEPORT.

President — George H. Wood, 505 Park avenue, Bridgeport.
Vice-President — L. Anderson, 112 Clinton avenue, Bridgeport.
Financial Secretary — S. A. Harrison, 400 Central avenue, Bridgeport.
Recording Secretary — W. W. Fenton, 640 William street, Bridgeport.
Treasurer — E. West, Fairfield.

MACHINISTS ASSOCIATION, NO. 259 — DERBY.

President — Patrick Waters, Derby.
Financial Secretary — Edward Haas, 80 Elizabeth street, Derby.
Recording Secretary — W. H. Uebelhour, 31 Third street, Derby.
Treasurer — Daniel Connors, Derby.

MACHINISTS ASSOCIATION, NO. 354 — HARTFORD.

President — John A. Cahill, 992 Broad street, Hartford.
Vice-President — A. E. Moran, 302 Park street, Hartford.
Secretary — James M. Dow, 31 Affleck street, Hartford.
Treasurer — Philip S. Ryan, 250 Zion street, Hartford.

MACHINISTS ASSOCIATION, NO. 436 — NEW BRITAIN.

President — Arthur J. Reynolds, 91 Bassett street, New Britain.
Secretary — George S. Tourtelotte, 422 North Stanley street, New Britain.
Treasurer — Charles H. McKirdy, 422 North Stanley street, New Britain.

MACHINISTS ASSOCIATION, NO. 366 — NEW HAVEN.

President — J. W. Nestor, 162 Wooster street, New Haven.
Secretary — Dennis O'Dea, 16 Orange street, New Haven.
Treasurer — John F. Clarke, 124 Cedar street, New Haven.

MACHINISTS ASSOCIATION, NO. 349 — WATERBURY.

President — George Gale, 50 East Clay street, Waterbury.
Financial Secretary — John Withey, 1162 Bank street, Waterbury.
Recording Secretary — John Rusgrove, 12 Jefferson street, Waterbury.
Treasurer — Edmund Loyot, 30 Clark street, Waterbury.

METAL POLISHERS UNION, NO. 122 — BRANFORD.

President — James D. Carey, P. O. Box 268, Branford.
Financial Secretary — E. R. Monroe, P. O. Box 286, Branford.
Recording Secretary — John H. O'Neil, Branford.

METAL POLISHERS UNION, NO. 40 — BRIDGEPORT.

President — Herbert Fitch, Bridgeport.
Vice-President — John A. Bagley, 180 State street, Bridgeport.
Secretary — Charles Coleman, 74 Gregory street, Bridgeport.
Treasurer — Harry Howard, Sr., 109 Catherine street, Bridgeport.

METAL POLISHERS UNION, NO. 86 — BRISTOL.

President — A. Morton, Bristol.
Financial Secretary — D. McCarthy, 149 North Main street, Bristol.
Recording Secretary — E. Colvin, Bristol.

METAL POLISHERS UNION, NO. 54 — DERBY.

President — William T. Wilson, 81 Pratt street, Ansonia.
Financial Secretary — James T. Ryan, 12 Hawthorn avenue, Derby.
Recording Secretary — Ernie Clay Wilson, Shelton.
Treasurer — Thomas Horan, 12 Cherry street, Derby.

METAL POLISHERS UNION, NO. 35 — HARTFORD.

President — W. H. Smith, 213 Lawrence street, Hartford.
Financial Secretary — J. J. Kennedy, 338 Park street, Hartford.

METAL POLISHERS UNION, NO. 23 — MERIDEN.

President — Robert Brewster, 140 Pratt street, Meriden.
Secretary — James P. Hogan, 130 Foster street, Meriden.

METAL POLISHERS UNION, NO. 126 — NEW BRITAIN.

President — John Havesy, New Britain.
Financial Secretary — James Roach, New Britain.
Recording Secretary — William C. Fisher, 30 John street, New Britain.

METAL POLISHERS UNION, NO. 92 — STAMFORD.

President — G. H. Fox, Richmond Hill, Stamford.
Financial Secretary — John Cavanaugh, 29 Garden street, Stamford.
Recording Secretary — Edward Clark, 24 Pacific street, Stamford.

METAL POLISHERS UNION, NO. 72 — THOMPSONVILLE.

President — John E. Dineen, Thompsonville.
Financial Secretary — J. H. McCarthy, P. O. Box 693, Thompsonville.
Recording Secretary — F. P. O'Brien, P. O. Box 499, Thompsonville.

METAL POLISHERS UNION, NO. 104 — TORRINGTON.

President — J. J. Scanlon, Prospect street, Torrington.
Financial Secretary — John Oliver, 21 Railroad street, Torrington.
Recording Secretary — H. F. Murphy, 280 East Main street, Torrington.

METAL POLISHERS UNION, NO. 73 — WALLINGFORD.

President — J. F. Kenner, Wallingford.
Financial Secretary — John Hoban, Wallingford.
Recording Secretary — J. Merchant, Wallingford.

METAL POLISHERS UNION, NO. 37 — WATERBURY.

President — John Galvin, 151 Charles street, Waterbury.
Financial Secretary — Charles Teller, 750 East Main street, Waterbury.
Recording Secretary — Robert Rourke, 7 Cossette street, Waterbury.

METAL POLISHERS UNION, NO. 120 — WATERBURY.

President — Henry Stoeffler, 645 South Main street, Waterbury.
Financial Secretary — C. L. Griffin, 134 South Leonard street, Waterbury.
Recording Secretary — L. C. Griffin, 134 South Leonard street, Waterbury.

METAL POLISHERS UNION, NO. 96 — WEST CORNWALL.

President — James F. Spaine, West Cornwall.
Financial Secretary — Henry Koehler, West Cornwall.
Recording Secretary — J. Thompson Mallison, Lock Box 20, West Cornwall.

MUSICIANS UNION — ANSONIA.

President — George A. Cargill, Mt. Pleasant street, Derby.
Secretary — Henry A. Jordan, 54 Main street, Ansonia.
Treasurer — John Walters, 138 Prospect street, Ansonia.

MUSICIANS UNION — BRIDGEPORT.

President — George T. McCarthy, 183 Brook street, Bridgeport.
Vice-President — B. J. Brady, 95½ Madison avenue, Bridgeport.
Secretary — J. D. Bouton, 106 James street, Bridgeport.
Treasurer — George P. Sanborn, 180 Wood avenue, Bridgeport.

MUSICIANS UNION — DANBURY.

President — F. C. Dauchy, 36 New street, Danbury.
Vice-President — E. W. Ritch, 68 Pleasant street, Danbury.
Secretary — Harry W. Ruffels, 9 New street, Danbury.
Treasurer — Arthur Clark, 59 Washington avenue, Danbury.

MUSICIANS UNION — HARTFORD.

President — F. C. Louis Schmidt, 35 Chapel street, Hartford.
Vice-President — George F. Johnson, 724 Main street, Hartford.
Secretary — D. J. Crimmins, 53 Franklin avenue, Hartford.
Treasurer — George S. Carey, 464 Windsor avenue, Hartford.

MUSICIANS UNION — MERIDEN.

President — T. M. Crowley, 69 West Main street, Meriden.
Secretary — John H. Meehan, 79 Park street, Meriden.
Treasurer — Henry J. Burbank, 73 Twiss street, Meriden.

MUSICIANS UNION, NO. 52 — NORWALK.

President — Rufus J. Smith, 24 Washington street, South Norwalk.
Secretary — Henry C. Smith, 8 Day street, South Norwalk.
Treasurer — John W. Steegmuller, 17 Quintard avenue, South Norwalk.

MULE SPINNERS UNION — TAFTVILLE.

President — John J. Day, Taftville.
Vice-President — John Oates, Taftville.
Secretary — Timothy C. McCarthy, Taftville.
Treasurer — Dennis C. Murphy, Taftville.

PAINTERS AND DECORATORS UNION — BRIDGEPORT.

President — John Knablin, 170 Park street, Bridgeport.
Secretary — John Beard, 198 State street, Bridgeport.
Treasurer — Dwight Farnham, 157 Helen street, Bridgeport.

PAINTERS AND DECORATORS UNION, NO. 99 — DERBY.

President — William Martin, Ansonia.
Vice-President — T. Degreff, Shelton.
Financial Secretary — T. G. Buckley, Ansonia.
Recording Secretary — F. D. Bentley, 308 Hawkins street, Derby.
Treasurer — Frank Ufford, Shelton.

PAINTERS AND DECORATORS UNION, NO. 21 — NEW BRITAIN.

President — Joseph H. Bahon, 451 West Main street, New Britain.
Secretary — Joseph S. Magson, 240 Maple street, New Britain.
Treasurer — George R. Mitchel, 9 Yale street, New Britain.

PAINTERS AND DECORATORS UNION, NO. 169 — TORRINGTON.

President — B. H. Fallon, 13 Hungerford place, Torrington.
Financial Secretary — F. W. Reading, 50 Water street, Torrington.
Recording Secretary — H. E. Vail, 7 Riverside avenue, Torrington.
Treasurer — William Baldauf, Winsted road, Torrington.

PATTERNMAKERS LEAGUE — HARTFORD.

President — William Gregory, 54 Brown street, Hartford.
Financial Secretary — Frank Claffey, 41 Laurel street, Hartford.
Recording Secretary — Hugh Mackie, 12 Pawtucket street, Hartford.
Treasurer — Peter Williamson, 47 Putnam street, Hartford.

PLUMBERS UNION — BRIDGEPORT.

President — William Kirk, 97 Black Rock avenue, Bridgeport.
Financial Secretary — Henry Cope, 351 Clinton avenue, Bridgeport.
Recording Secretary — A. L. McGrath, 687 William street, Bridgeport.
Treasurer — Arthur Riley, 500 Hallett avenue, Bridgeport.

PLUMBERS UNION, NO. 132 — DERBY.

President — A. J. Carr, Water street, Derby.
Vice-President — T. J. Gannon, Smith street, Derby.
Secretary and Treasurer — Philip H. Little, 79 Smith street, Derby.

PLUMBERS UNION — HARTFORD.

President — John J. Dunn, 226 Zion street, Hartford.
Financial Secretary — P. J. McLaughlin, 15 Zion street, Hartford.
Recording Secretary — J. A. MacNabb, 1322 Broad street, Hartford.
Treasurer — Thomas Keefe, 72 Bellevue street, Hartford.

PLUMBERS UNION — MERIDEN.

President — Daniel J. Lynch, 613 East Main street, Meriden.
Secretary — William J. Smith, 41 Cedar street, Meriden.
Treasurer — William H. Gleason, 71 Lewis avenue, Meriden.

PLUMBERS UNION — NEW BRITAIN.

President — Thomas Quinlivan, 128 North street, New Britain.
Secretary — William F. Lynch, 47 Lawler street, New Britain.
Treasurer — Patrick H. Gilbert, 96 Beaver street, New Britain.

PLUMBERS UNION — NEW HAVEN.

President — John Cannon, 29 Spruce street, New Haven.
Vice-President — Edward Cashman, 214 Hamilton street, New Haven.
Secretary — John H. Coffey, 167 Grafton street, New Haven.
Treasurer — John Roach, 224 Congress avenue, New Haven.

PLUMBERS UNION, NO. 169 — NORWICH.

President — John J. Shugrue, 59 Union street, Norwich.
Vice-President — Thomas Hedd, Greeneville.
Secretary — Joseph E. Burns, 126 Baltic street, Norwich.
Treasurer — Thomas F. Mullin, 39 West Thames street, Norwich.

PLUMBERS UNION, NO. 22 — WATERBURY.

President — James Robbinson, 36 State street, Waterbury.
Secretary — Thomas W. Gill, 265 South Main street, Waterbury.
Treasurer — Thomas J. Morgan, 187 Wolcott street, Waterbury.

PRINTING PRESSMEN'S UNION, NO. 75 — HARTFORD.

President — Anthony H. Merz, 103 Hudson street, Hartford.
Secretary — Charles H. Stone, 4 Walnut street, Hartford.
Treasurer — George M. Miller, 68 Hungerford street.

PRINTING PRESSMEN'S UNION, NO. 74 — NEW HAVEN.

President — Dale K. Fitzgerald, 119 Davenport avenue, New Haven.
Vice-President — Daniel J. Scott, 72 Audubon street, New Haven.
Treasurer — Andrew A. Russell, 73 Kensington street, New Haven.

RAILWAY CONDUCTORS, DIVISION NO. 50 — HARTFORD.

Chief Conductor — John J. Bolger, 28 Olmsted street, East Hartford.
Secretary and Treasurer — C. S. Brigham, 721 Main street, Hartford.

RAILWAY CONDUCTORS, DIVISION — NEW HAVEN.

President — Charles Vaughn, 4 Monroe street, South Norwalk.
Vice-President — J. H. Griffin, 24 Union street, South Norwalk.
Secretary and Treasurer — Frank J. Flannigan, 272 Portsea street, New Haven.

RAILWAY CONDUCTORS, "INDEPENDENT ORDER" — NEW HAVEN.

President — E. A. Bacon, 352 Howard avenue, New Haven.
Treasurer — William W. Pardee, 58 Minor street, New Haven.

RAILROAD TRAINMEN'S LODGE, NO. 111 — BRIDGEPORT.

Master — Robert Shaw, 128 Broad street, Bridgeport.
Secretary — George C. Stewart, 156 Warren street, Bridgeport.
Financier — John Blackburn, 444 East Main street, Bridgeport.

RAILROAD TRAINMEN'S LODGE, NO. 332 — DANBURY.

Master — Andrew Healy, 8 Moss avenue, Danbury.
Secretary — Philip T. Bird, 17 Hamilton street, South Norwalk.
Financier — Franklin Manent, 10 Chichester place, Danbury.

RAILROAD TRAINMEN'S LODGE, NO. 551 — EAST HARTFORD.

Master — Orville Mott, 22 Tolland street, East Hartford.
Secretary — Adam Brand, 100 Burnside avenue, East Hartford.
Financier — Peter O'Hern, 773 Main street, East Hartford.

RAILROAD TRAINMEN'S LODGE, NO. 118 — HARTFORD.

Master — F. H. Osborn, P. O. Box 28, Windsor Locks.
Secretary — G. C. Van Ostrem, 85 Albany avenue, Hartford.
Financier — J. A. Daley, 3 Hamilton street, Hartford.

RAILROAD TRAINMEN'S LODGE, NO. 201 — NEW HAVEN.

Master — John H. Monk, 110 Columbus avenue, New Haven.
Secretary — G. A. Keefer, 5 Daggett street, New Haven.
Financier — A. J. Dutton, 82 Morris street, New Haven.

RAILROAD TRAINMEN'S LODGE, NO. 496 — NEW LONDON.

Master — William S. Ormsby, Orchard street, New London.
Secretary — G. S. McLaughlin, 23 Chrystal avenue, East New London.
Financier — G. W. McNamara, 8 Stony Hill street, New London.

RAILROAD TRAINMEN'S LODGE, NO. 398 — STAMFORD.

Master — Earnest R. Wilson, 66 Spring street, South Norwalk.
Secretary — Theodore Junger, 32 Ludlow street, Stamford.
Financier — J. W. Moffett, 835 Southern Boulevard, New York city.

RAILROAD TRAINMEN'S LODGE, NO. 423 — WATERBURY.

Master — Frank J. Foley, 3 East Clay street, Waterbury.
Secretary — Charles E. Flint, 13 French street, Waterbury.
Financier — William Cousey, 31 South Fifth street, Waterbury.

SHOE MAKERS UNION — DANBURY.

President — John Wagner, Danbury.
Secretary — Frank Bonedeo, Danbury.
Treasurer — John Capellaro, 49 White street, Danbury.

STATIONARY ENGINEERS ASSOCIATION — ANSONIA.

President — Joseph Hulley, Franklin street, Ansonia.
Secretary — Robert C. Bell, 36 Fifth street, Ansonia.
Treasurer — William Kemp, Lester street, Ansonia.

STATIONARY ENGINEERS ASSOCIATION — BRIDGEPORT.

President — E. V. Sloan, 566 State street, Bridgeport.
Secretary — Joseph Bellwood, 117 Black Rock avenue, Bridgeport.
Treasurer — W. M. Reeves, 185 Pembroke avenue, Bridgeport.

STATIONARY ENGINEERS ASSOCIATION — HARTFORD.

President — P. J. Barrett, 354 Park street, Hartford.
Secretary — L. M. Marvel, 184 Putnam street, Hartford.
Treasurer — George J. Miller, 68 Lawrence street, Hartford.

STATIONARY ENGINEERS ASSOCIATION — MERIDEN.

President — August E. Greene, 381 Pratt street, Meriden.
Secretary — Frank W. Shillitto, Jr., Alcove street, Meriden.
Treasurer — J. C. Bachelder, 69 Goodwill avenue, Meriden.

STATIONARY ENGINEERS ASSOCIATION — NEW BRITAIN.

President — Luke W. Kimball, 595 East Main street, New Britain.
Secretary — William T. Chaloner, 48 Winthrop street, New Britain.
Treasurer — Charles E. McIntyre, 28 So. Burritt street, New Britain.

STATIONARY ENGINEERS ASSOCIATION, NO. 800 — NEW HAVEN.

President — Jacob Ashton, 81 Dickerman street, New Haven.
Secretary — James Mason, 278 Howard avenue, New Haven.
Treasurer — Fred Perrigo, East Haven.

STATIONARY ENGINEERS ASSOCIATION — NORWALK.

President — Theodore R. Fancher, 55 Maple avenue, Norwalk.
Secretary — C. W. Kendrick, 52 Spring street, South Norwalk.
Treasurer — Harry S. Pickering, 87 West street, South Norwalk.

STATIONARY ENGINEERS ASSOCIATION, NO. 597 — WATERBURY.

President — John Davidson, 7 Pratt street, Waterbury.
Secretary — James Schofield, 577 South Main street, Waterbury.
Treasurer — T. E. Guest, Garnett House, South Main street, Waterbury.

STREET RAILWAY EMPLOYES ASSOCIATION — MERIDEN.

Names of officers withheld.

STONE CUTTERS UNION, NO. 1 — HARTFORD.

President — Joseph M. Larkin, 33 Hamilton street, Hartford.
Secretary — John L. Dorsey, 130 Front street, Hartford.
Treasurer — James H. O'Brien, 8 Winter street, Hartford.

STONE MASONS UNION, NO. 4 — BRIDGEPORT.

President — Michael French, 38 Gilmor street, Bridgeport.
Secretary — Thomas Shaw, 803 Norman street, Bridgeport.
Treasurer — James Grandfield, 103 Jane street, Bridgeport.

STONE MASONS UNION, NO. 5 — HARTFORD.

President — John T. Madden, 26 Cedar street, Hartford.
Financial Secretary — William J. Earle, 77 Hamilton street, Hartford.
Recording Secretary — Michael Earle, 77 Hamilton street, Hartford.
Treasurer — Michael McNulty, 6 Cedar street, Hartford.

STONE MASONS UNION, NO. 7 — NEW HAVEN.

President — William Simon, 13 Summer street, New Haven.
Secretary — William Geary, 146 Poplar street, New Haven.
Treasurer — John McDermott, 53 Winchester avenue, New Haven.

TAILORS UNION — BRIDGEPORT.

President — Cornelius Driscoll, 341 Main street, Bridgeport.
Secretary — John Goulden, 80 Cannon street, Bridgeport.
Treasurer — Michael Rock, 341 Main street, Bridgeport.

TAILORS UNION, NO. 7 — DANBURY.

President — A. Wiedl, 221 Main street, Danbury.
Secretary — A. Hofmann, 9 Clark street, Danbury.
Treasurer — Charles Hahn, 265 Main street, Danbury.

TAILORS UNION, NO. 22 — NEW HAVEN.

President — T. Coxerter, 38 Winchester avenue, New Haven.
Secretary — H. J. Heilemann, 32 Greenwood street, New Haven.
Treasurer — C. V. Ellis, 214 Main street, West Haven.

TEAM DRIVERS UNION, NO. 14 — HARTFORD.

President — Jeremiah T. Looney, 44 Village street, Hartford.
Vice-President — William Haupt, 36 Sanford street, Hartford.
Financial Secretary — Benjamin P. Woodward, 46 Hudson street, Hartford.
Recording Secretary — Michael J. Beakey, 55 Front street, Hartford.
Treasurer — Charles W. Hunt, 19 East street, Hartford.

TINNERS UNION — BRIDGEPORT.

President — Samuel Miller, 487 North avenue, Bridgeport.
Financial Secretary — G. B. Houston, 203 Lafayette street, Bridgeport.
Corresponding Secretary — Al Loeser, 86 Elm street, Bridgeport.
Treasurer — Thomas Brady, 272 Stratford avenue, Bridgeport.

TINNERS UNION, NO. 77 — HARTFORD.

President — William McCoy, 141 Park street, Hartford.
Vice-President — Daniel Kelley, 32 Church street, Hartford.
Secretary — W. H. Lawler, 50 Lawrence street, Hartford.
Treasurer — George B. Bradford, 231 Bellevue street, Hartford.

THEATRICAL MECHANICS ASSOCIATION — BRIDGEPORT.

President — H. H. Jennings, Sr., 282 Main street, Bridgeport.
Secretary — James Horahan, 305 Wheeler avenue, Bridgeport.
Treasurer — H. H. Jennings, Jr., 282 Main street, Bridgeport.

TRADES COUNCIL, "PRINTING" — HARTFORD.

President — Severin Wilson, 17 Buckingham street, Hartford.
Secretary and Treasurer — T. Myles, 17 Union street, Hartford.

TRADES COUNCIL — NEW BRITAIN.

President — George Tourtelotte, 422 North Stanley street, New Britain.
Secretary — J. H. Bahon, 451 West Main street, New Britain.
Treasurer — George Baisden, 47 Madison street, New Britain.

TRADES COUNCIL — NEW HAVEN.

President — Alex. C. R. Ryder, 345 Whalley avenue, New Haven.
Secretary — Meyer Stodel, 245 Washington avenue, New Haven.
Treasurer — Henry Ellis, P. O. Box 1622, New Haven.

TRADES COUNCIL, "BUILDING" — WATERBURY.

President — H. E. Coddington, 345 Walnut street, Waterbury.
Secretary — John H. White, 6 Eastern avenue, Waterbury.
Treasurer — J. J. Grady, 68 Fuller street, Waterbury.

TRADES COUNCIL, "UNITED" — WATERBURY.

President — Walter Crossland, P. O. Box 560, Waterbury.
Secretary — William D. Adnitt, 577 South Main street, Waterbury.
Treasurer — Phil Daly, 7 Sylvan avenue, Waterbury.

TYPOGRAPHICAL UNION, NO. 252 — BRIDGEPORT.

President — H. R. Kelt, 297 Cottage street, Bridgeport.
Secretary — R. T. Cherry, 86 James street, Bridgeport.
Treasurer — John J. O'Neil, 387 Olive street, Bridgeport.

TYPOGRAPHICAL UNION, NO. 143 — DANBURY.

President — F. G. Capron, 246 Main street, Danbury.
Vice-President — W. F. Dobbs, 38 Lake avenue, Danbury.
Secretary — S. C. O'Connor, 53 West street, Danbury.
Treasurer — J. Steward Warren, 31 George street, Danbury.

TYPOGRAPHICAL UNION, NO. 127 — HARTFORD.

President — J. G. Bacon, 106 Capen street, Hartford.
Secretary — S. T. Pfund, 203 Ashley street, Hartford.
Treasurer — A. F. Miles, 73 Park street, Hartford.

TYPOGRAPHICAL UNION — MERIDEN.

President — A. F. Daniels, Bloxham House, Meriden.
Secretary — H. C. Maydwell, 350 Cook avenue, Meriden.
Treasurer — Richard Dossin, 37 North Fourth street, Meriden.

TYPOGRAPHICAL UNION, NO. 47 — NEW HAVEN.

President — Edward M. Martin, 62 Dixwell avenue, New Haven.
Secretary — Joseph J. Reilly, 131 Liberty street, New Haven.
Treasurer — Asa A. Yale, 40 Elliott street, New Haven.

TYPOGRAPHICAL UNION, NO. 159 — NEW LONDON.

President — Samuel C. Hawman, 18 Hempsted street, New London.
Vice-President — Ambrose Higgins, 133 State street, New London.
Secretary and Treasurer — George H. Haywood, 9 Amity street, New London.

TYPOGRAPHICAL UNION, NO. 100 — NORWICH.

President — William H. Eagles, 207 West Main street, Norwich.
Vice-President — John Trankla, 52 Oak street, Norwich.
Secretary — Edward H. Crocker, 80 Chestnut street, Norwich.
Treasurer — Jerry Ryan, 49 Church street, Norwich.

TYPOGRAPHICAL UNION, NO. 329 — WATERBURY.

Pesident — J. F. Sayers, 60 Scoville street, Waterbury.
Secretary — Peter O'Connell, 136 West Main street, Waterbury.
Treasurer — John H. Austin, "Hotel Savoy," Waterbury.

WEAVERS UNION, "ELASTIC GORING" — BRIDGEPORT.

President — Frederick W. Taylor, 1399 Park avenue, Bridgeport.
Financial Secretary — Robert Warwick, 486 Logan street, Bridgeport.
Recording Secretary — Thomas Bromley, 421 Hollister avenue, Bridgeport.
Treasurer — J. J. Howarth, 402 John Street, Bridgeport.

WEAVERS UNION — NEW LONDON.

Names of officers withheld.

WEAVERS UNION, "ELASTIC GORING" — NORWALK.

President — James Moore, 14 Plymouth avenue, Norwalk.
Secretary — William J. Moore, 30 Wilton avenue, Norwalk.
Treasurer — David Chittin, 17 Center avenue, Norwalk.

WEAVERS SOCIETY, "LACE CURTAINS" — TARIFFVILLE.

President — Joseph Dent, P. O. Box 54, Tariffville.
Secretary — G. W. Wakeling, P. O. Box 4, Tariffville.
Treasurer — E. Oldham, P. O. Box 26, Tariffville.

WOOD CARVERS ASSOCIATION — NEW HAVEN.

Financial Secretary — George Soder, 35 Lyon street, New Haven.
Corresponding Secretary — Henry Plate, West Haven.
Treasurer — Frank Dahlmeyer, 32 Prout street, New Haven.

Part V

Labor Laws of Connecticut

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INTRODUCTION TO THE LABOR LAWS OF CONNECTICUT.

Herewith is presented a compilation of the labor laws of the State of Connecticut. This work has been performed because of a general demand by citizens of the state upon this bureau and upon the Factory Inspector for the labor laws of Connecticut. It has been the custom of the bureau, from time to time, to present the new legislation relating to labor, but here an attempt has been made to give all the laws of this state directly affecting the wage-earners.

In 1890, the United States Department of Labor compiled the labor laws of the states of the Union, and the volume has been much in demand among the people of Connecticut. It has done excellent service, but succeeding legislatures have so transformed the laws that it is now out of date. The following compilation contains about twice the material that the national bureau's work had.

It is a striking fact that the interests of the laborer are so diversified, so far-reaching, and involve so much, that really the General Statutes and Public Acts are all labor laws. They are the real authority that the workingman, be he employer or employe, should turn to when he desires legal information. The following are mere cullings, gleanings from the great mass of law, which, it is presumed, will possess especial interest for the so-called laboring classes.

So, as may be imagined, it has been an extremely difficult task to decide what portions of the Statutes should be printed and what should be omitted. For instance, laws of taxation are extremely interesting to and affect the laboring classes, yet these are not labor laws, in the strict sense; therefore, they have been

omitted. And, too, all of the mechanics' lien and foreign attachment laws are most vital to wage-workers, but reasonable space herein forbade the reproduction of those enactments in full, but the most salient sections are here given.

To make this compilation as useful as possible, no little pains have been taken with the following index to the labor laws. If this work fills the demand which has been made upon the bureau and Factory Inspector, the compiler will be satisfied with his work and pleasantly rewarded for his pains. The laws follow, the section and chapter numbers being the same as are found in the General Statutes and Public Acts.

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THE LAWS.

Children of Indians may be indentured when.

SEC. 30. If any member of any tribe of Indians shall suffer his children to live in idleness, or does not provide competently for them, whereby they are exposed to want, or if any poor children belonging to any such tribe live idly or are exposed to want, the overseer of such tribe, with the assent of two justices of the peace residing in the town where such tribe live, may indenture them to some proper trade, — males till the age of eighteen years, and females till the age of sixteen years, or to the time of their marriage within that age.

Certificate of mechanics' lien.

SEC. 77. Whenever any certificate of mechanics' lien lodged with a town clerk does not disclose the name of the owner of the premises against which such lien is claimed, such town clerk shall ascertain and index the same from such information as he may be able to obtain from the town records or otherwise; but he shall not be liable for mistake in ascertaining such name.

Plumbing and house drainage.

SEC. 160. The court of common council of any city, the warden and burgesses of any borough, or the selectmen of any town shall have power, by ordinances or by-laws, to regulate plumbing and house drainage, and the licensing of master plumbers.

Threats, intimidation, and undue influence.

SEC. 276. Every person who shall, at or within sixty days prior to any such meeting, attempt to influence the vote of any operative in his employ by threats of withholding employment from him, or by promises of employment, or who shall dismiss any operative from his employment on account of any vote he may have given at any such meeting, shall be fined not less than one hundred dollars, nor more than five hundred dollars, or imprisoned not less than six months, or more than twelve months, or both.

Weekly payments to employes.

SEC. 344. The Comptroller shall make weekly payments of wages to all persons employed by him about the State capitol and grounds, except those who are employed only during a session of the General Assembly, or whose compensation is fixed by law.

Claims for labor preferred.

SEC. 514. All debts due to any laborer or mechanic for personal wages, from any insolvent debtor whose estate is in settlement, for any labor performed by him within three months next preceding the commencement of proceedings in insolvency, shall be allowed by the commissioners on his estate, and paid in full by the trustee, to the amount of one hundred dollars, before the general liabilities of such debtors are paid.

ACTS OF 1895.

CHAPTER CCXLII.

An Act concerning Preferred Claims against Insolvent Corporations.

Be it enacted by the Senate and House of Representatives in General Assembly convened:

Debts due for labor preferred claims.

All debts due to any laborer or mechanic for personal wages from any insolvent corporation of which a receiver has been appointed by judicial authority, for any labor performed by him within three months next preceding the appointment of such receiver, shall be allowed and paid in full by said receiver, to the amount of one hundred dollars, before the general liabilities of such corporation are paid.

Approved, June 28, 1895.

ACTS OF 1897.

CHAPTER XL.

An Act concerning Claims for Labor against Corporations and Copartnerships.

Be it enacted by the Senate and House of Representatives in General Assembly convened:

Debts due for labor preferred claims.

SECTION 1. All debts due to any laborer or mechanic for personal wages, from any corporation or copartnership for which a receiver shall be appointed, for any labor performed for such corporation or copartnership within three months next preceding the service of the application for the appointment of a receiver, shall be paid in full by the receiver, to the amount of one hundred dollars, before the general liabilities of such corporation or copartnership are paid.

Repeal.

SEC. 2. Chapter CCXLII of the public acts of 1895 and all other acts or parts of acts inconsistent herewith are hereby repealed.

SEC. 3. This act shall take effect from its passage.

Approved, March 17, 1897.

Exemptions from warrant and execution.

SEC. 1164. The following property shall be exempted, and not liable to be taken by warrant or execution, namely: Of the property of any one person, his necessary apparel and bedding, and household furniture necessary for supporting life, arms,

military equipments, uniforms, or musical instruments owned by any member of the militia for military purposes, any pension moneys received from the United States, while in the hands of the pensioner, implements of the debtor's trade, his library, not exceeding five hundred dollars in value, one cow, not exceeding one hundred and fifty dollars in value, any number of sheep not exceeding ten, nor exceeding in all one hundred and fifty dollars in value, two swine and the pork produced from two swine, or two swine and two hundred pounds of pork, and poultry not exceeding twenty-five dollars in value; of the property of any one person having a wife or family, twenty-five bushels of charcoal, two tons of other coal, two hundred pounds of wheat flour, two cords of wood, two tons of hay, two hundred pounds each of beef and fish, five bushels each of potatoes and turnips, ten bushels each of Indian corn and rye, and the meal or flour manufactured therefrom, twenty pounds each of wool and flax, or the yarn or cloth made therefrom; the horse of any practicing physician or surgeon of a value not exceeding two hundred dollars, and his saddle, bridle, harness, and buggy; one boat, owned by one person, and used by him in the business of planting or taking oysters or clams, or taking shad, together with the sails, tackle, rigging, and implements used in said business, not exceeding in value two hundred dollars; one sewing machine, being the property of any one person using it, or having a family; one pew, being the property of any person having a family who ordinarily occupy it; and lots in any burying-ground, appropriated by its proprietors for the burial-place of any person or family.

Foreign attachment, wages exempt up to $50.

SEC. 1231. When the effects of the defendant in any civil action in which a judgment or decree for the payment of money may be rendered are concealed in the hands of his agent or trustee, so that they cannot be found to be attached, or where a debt is due from any person to such defendant, or where any debt, legacy, or distributive share is or may become due to such defendant from the estate of any deceased person or insolvent debtor, the plaintiff may insert in his writ a direction to the officer to leave a true and attested copy thereof and of the accompanying complaint, at least twelve days before the session of the court to which it is returnable, with such agents, trustee, or debtor of the defendant, or, as the case may be, with the executor, administrator, or trustee of such estate, or at the usual place of abode of such garnishee; and from the time of leaving such copy, all the effects of the defendant in the hands of any such garnishee, and any debt due from any such garnishee to the defendant, and any debt, legacy, or distributive

share due, or that may become due to him from such executor, administrator, or trustee in insolvency, not exempt from execution, shall be secured in the hands of such garnishee to pay such judgment as the plaintiff may recover. But so much of any debt which has accrued by reason of the personal services of the debtor as shall not exceed fifty dollars, including wages due to him for the personal services of any minor child under the age of twenty-one years, shall be exempted and not liable to be taken by foreign attachment or execution; but this provision shall not apply to any debt due June first, eighteen hundred and eighty-seven. And all benefits allowed by any association of persons in this state, towards the support of any of its members incapacitated by sickness or infirmity from attending to his usual business, shall also be exempted, and not liable to be taken by foreign attachment or execution.

ACTS OF 1895.

CHAPTER CCCXLII.

An Act relating to Foreign Attachment.

Be it enacted by the Senate and House of Representatives in General Assembly convened:

No exemption in action for wages.

Section 1231 of the general statutes is hereby amended to read as follows: When the effects of the defendant in any civil action in which a judgment or decree for the payment of money may be rendered are concealed in the hands of his agent or trustee, so that they cannot be found or attached, or where a debt is due from any person to such defendant, or where any debt, legacy, or distributive share is or may become due to such defendant from the estate of any deceased person or insolvent debtor, the plaintiff may insert in his writ a direction to the officer to leave a true and attested copy thereof and of the accompanying complaint, at least twelve days before the session of the court to which it is returnable, with such agent, trustee, or debtor of the defendant, or, as the case may be, with the executor, administrator, or trustee of such estate, or at the usual place of abode of such garnishee; and from the time of leaving such copy, all the effects of the defendant in the hands of any such garnishee, and any debt due from any such garnishee to the defendant, and any debt, legacy, or distributive share due, or that may become due to him from such executor, administrator, or trustee in insolvency, not exempt from execution, shall be secured in the hands of such garnishee to pay such judgment as the plaintiff may recover. But so much of any debt which has accrued by reason of the personal services of the defendant as shall not exceed fifty dollars, including wages due for the personal services of any minor child,

shall be exempted and not liable to be taken by foreign attachment or execution, but there shall be no exemption of any debt accrued by reason of the personal services of the defendant against a claim for the defendant's personal board. The exemption provided in this section shall not apply to any debt due June first, eighteen hundred and eighty-seven. And all benefits allowed by any association of persons in this state towards the support of any of its members incapacitated by sickness or infirmity from attending to his usual business shall also be exempted, and not liable to be taken by foreign attachment or execution. And all moneys due the debtor from any insurance company upon policies issued for insurance upon property, either real or personal, which is exempt from attachment and execution, shall in like manner be exempted to the same extent as the property so insured.

Approved, July 9, 1895.

Assignment of future earnings.

SEC. 1247. No assignment of future earnings shall be valid against an attaching creditor of the assignor unless made to secure a *bona fide* debt due at the date of such assignment, the amount of which shall be stated therein as nearly as the same can be ascertained, nor unless the term for which such earnings are assigned, shall be definitely limited in the assignment; nor unless such assignment shall be recorded before such attachment in the town clerk's office in the town where the assignor resides, or, if he reside without the state, in the town where the employer resides, and a copy thereof left with the employer from whom the wages are to become due.

Unlawful exhibition or employment of child under the age of twelve years.

SEC. 1417. Every person who shall exhibit, use, employ, apprentice, give away, let out, or otherwise dispose of any child under the age of twelve years, in or for the vocation, occupation, service, or purpose of rope or wire walking, dancing, skating, bicycling, or peddling, or as a gymnast, contortionist, rider, or acrobat, in any place whatever; or for or in any obscene, indecent, or immoral purpose, exhibition or practice whatsoever; or for or in any business, exhibition, or vocation, injurious to the health, or dangerous to the life or limb of such child; or who shall cause, procure, or encourage any such child to engage therein, shall be fined not more than two hundred and fifty dollars, or imprisoned not less than thirty days, nor more than one year, or both. But nothing herein shall prevent the employment of any such child as a singer or musician, in any church or school, or in learning or teaching the science or practice of music.

Enticement of minor from lawful service.

SEC. 1484. Every person who shall eloign any lawfully bound minor from the service or custody of his master, or shall entice such minor from such service, shall be fined not

more than one hundred dollars, or imprisoned not more than six months.

Intimidation of employers and employes.

SEC. 1518. Every person who shall threaten, or use any means to intimidate any person to compel such person, against his will, to do or abstain from doing any act which such person has a legal right to do, or shall persistently follow such person in a disorderly manner, or injure, or threaten to injure, his property with intent to intimidate him, shall be fined not more than one hundred dollars, or imprisoned not more than six months.

Work on Sunday prohibited.

SEC. 1569. Every person who shall do any secular business or labor, except work of necessity or mercy, or keep open any shop, warehouse, or manufacturing or mechanical establishment, or expose any property for sale, or engage in any sport or recreation, on Sunday, between sunrise and sunset, shall be fined not more than four dollars, nor less than one dollar.

ACTS OF 1897.

CHAPTER CLXXXVIII.

An Act concerning the Observance of Sunday.

Be it enacted by the Senate and House of Representatives in General Assembly convened:

Sunday lengthened to 24 hours.

SECTION 1. Section 1569 of the general statutes is hereby amended to read as follows: Every person who shall do any secular business or labor, except works of necessity or mercy, or keep open any shop, warehouse, or manufacturing or mechanical establishment, or expose any property for sale, or engage in any sport between twelve o'clock Saturday night and twelve o'clock Sunday night, shall be fined not more than fifty dollars.

SEC. 2. This act shall not affect section 904 of the general statutes.

SEC. 3. All acts and parts of acts inconsistent herewith are hereby repealed.

SEC. 4. The provisions of this act shall not apply to the issuing of criminal process or any proceedings thereon.

Approved, May 25, 1897.

Fathers and guardians of minors may indenture them.

SEC. 1738. Fathers, and guardians of minors, may indenture them as apprentices, to learn some trade or profession, males till twenty-one, and females till eighteen years of age, or to the time of their marriage within that age, such minors assenting to, and subscribing the indenture.

When minors may indenture themselves.

SEC. 1739. Minors of the age of fourteen years, having no father or guardian within this state, may indenture themselves apprentices, with the approbation of the selectmen of the town.

Apprentices may be indentured by selectmen.

SEC. 1740. If any person, who has had relief from any town, shall suffer his children to mis-spend their time, and shall neglect to employ them in some honest calling, or if any person does not provide competently for his children, whereby they are exposed to want, or if any poor children in any town live idly or exposed to want, and there are none to take care of them, the selectmen of such town, with the assent of a justice of the peace, shall indenture such children, to be apprentices to some proper trade for said term; and may indenture them in like manner, to any society, incorporated for the purpose of educating and relieving orphans, or destitute children, whose place of business is in this state, and may contract with such society, to defray wholly or in part, the expenses of such child while in the institution, to an amount not exceeding one dollar and fifty cents a week; and such society shall have the same authority, with regard to such children, as over those surrendered to them by their parents.

Punishment of disobedient apprentices.

SEC. 1741. If any indentured apprentice shall neglect to serve, according to the terms of the indenture, or shall disobey the lawful commands of his master, or waste his property, or be guilty of any willful neglect of duty, the master may complain to any two justices of the peace in the town where he lives, who may issue a warrant and cause such apprentice to be brought before them, and inquire into the truth of the matters complained of; and if they find such apprentice guilty, may commit him to the workhouse, or to the common jail in the county, there to be confined at hard labor for not exceeding thirty days; but such justices may order such apprentice on reformation, to be released from prison, or may, if they judge best, cancel the indenture.

Runaway apprentices, how brought back.

SEC. 1742. When an indentured apprentice shall leave the service of his master, any justice of the peace, on complaint of the master, may issue his warrant to any proper officer to pursue such apprentice, and bring him back by force, at the expense of the master.

Apprentice may be released from service if neglected by master.

SEC. 1743. Parents, guardians, selectmen, trustees of the state reform school, and directors of the Connecticut industrial school for girls, shall inquire into the treatment of apprentices indentured by them respectively; and if, after the making of

such indenture, any masters and apprentices shall remove from the town where such indenture was made, to any other town in this state, or if the guardians of such apprentices are absent, refuse, or are unable to act, then the selectmen of the town where such masters and apprentices reside at the time, shall make such inquiry; and if they, the parents, guardians, selectmen, trustees, or directors aforesaid, find that the masters do not perform their part of the indenture, they shall complain to a justice of the peace in the town where such masters and apprentices reside, who shall cause the masters and apprentices to come before him, and reconcile them if he can, and if he cannot, may bind the master to appear at the next term of the court of common pleas, or district court, if there be such courts in the county in which such masters and apprentices reside, and if there are no such courts in said county, then he shall bind him to appear at the next superior court in same county, having civil jurisdiction, and also the apprentice, or give order for his custody in the meantime, and for his appearance at said court, and if it finds that the master has failed to perform his part of the indenture, it may discharge the apprentice from the service of the master and cancel the indenture, with costs against the master, and award execution accordingly; but if the complaint shall be found untrue, and without probable cause, it shall award costs to the master against the complainant.

Liability of absconding apprentice.

SEC. 1744. If any indentured apprentice shall abscond from the service of his master, such apprentice, when of age, shall be responsible for all damages thereby occasioned.

Employment of minors and women.

SEC. 1745. No minor under sixteen years of age, and no woman, shall be employed in laboring in any manufacturing, mechanical, or mercantile establishment more than ten hours in any day, except when it is necessary to make repairs to prevent the interruption of the ordinary running of the machinery, or where a different apportionment of the hours of labor is made for the sole purpose of making a shorter day's work for one day of the week. Every employer shall post in a conspicuous place in every room where such person is employed a notice stating the number of hours of work required of them on each day of the week; and the employment of any such person for a longer time in any day than so stated shall be deemed a violation of this section, unless it appears that such employment is to make up for time lost on some previous day of the same week in consequence of the stopping of the machinery upon which such person was employed or dependent for em-

ployment; but in no case shall the hours of labor exceed sixty in a week. Every person who willfully employs or has in his employment, or under his charge, any person in violation of this section, and every parent or guardian who permits any minor to be so employed, shall be fined not exceeding twenty dollars for this offense. A certificate of the age of the minor made by him or by his parent or guardian at the time of his employment in a manufacturing, mercantile, or mechanical establishment, shall be conclusive evidence of his age upon any trial of any person other than the parent or guardian for violation of this section. *Penalty.*

SEC. 1746. Eight hours of labor, performed in any day, by any one person, shall be a lawful day's work, unless otherwise agreed. *Legal day's work.*

SEC. 1747. Whoever shall employ in the manufacture of paper any person who shall not have had the small-pox, or been vaccinated, shall pay to any town all expenses caused it by the sickness of such person with small-pox, contracted while so employed. *Employes in paper factory to be vaccinated, etc.*

SEC. 1748. Any person or corporation who shall withhold any part of the wages of any person, because of any agreement expressed or implied requiring notice before leaving the employment, shall forfeit fifty dollars, half to him who shall sue therefor, and half to the state. *Withholding wages.*

SEC. 1749. Every corporation employing labor shall pay to its employes such compensation or wages as may be agreed upon, once a week; and such payment shall include all wages earned and unpaid up to the eighth day preceding the day of payment, and no deduction from said wages shall be made on account of such weekly payment. *Weekly payments.*

SEC. 1750. Every corporation which shall pay weekly to such of its employes as shall call at the usual place of payment for the same eighty per cent. of their estimated wages, earned and unpaid before the eighth day preceding the day of payment, making no discount on account of such weekly payment, and shall pay in full once in each month, and shall give notice of the same in its printed rules and regulations, shall be exempt from the provisions of the preceding section. *Exemption from.*

SEC. 1751. Any corporation violating the provisions of the two preceding sections shall forfeit the sum of fifty dollars, half to him who shall sue therefor, and half to the state. *Penalty.*

Wages paid before due not to be scaled.

SEC. 1752. No employer of labor, nor any person acting for him, shall in any manner or form make a discount or deduction from the wages of any person employed by him, when the wages of the employe or any part thereof are paid at an earlier time than that at which such wages would regularly have been paid. And any person or corporation violating this section shall forfeit not less than ten nor more than one hundred dollars, half to him who shall sue therefor, and half to the state.

Employment of children under thirteen.

SEC. 1753. No child under thirteen years of age shall be employed in any mechanical, mercantile, or manufacturing establishment.

SEC. 1754. Any person acting for himself, or as agent in any way, mechanical, mercantile, or manufacturing establishment, who shall employ or authorize or permit to be employed in the establishment any child, in violation of the preceding section, shall be fined not more than sixty dollars, and every week of such illegal employment shall be a distinct offense, provided that no person shall be punished under this section for the employment of any child, when at the time of such employment the employer shall demand, and thereafter during such employment keep on file, the certificate of any town clerk, or of the teacher of the school where such child last attended, stating that such child is more than thirteen years of age, or a like certificate of the parents or guardian of such child in such cases only where there is no record of the child's age in the office of the town clerk, and such child has not attended school in this state. Any parent or guardian who shall sign any certificate that his child or ward is more than thirteen years of age, when in fact such child or ward is under thirteen years of age, shall be fined not more than sixty dollars.

ACTS OF 1895.

CHAPTER CXVIII.

An Act concerning the Age Limit for the Employment of Children.

Be it enacted by the Senate and House of Representatives in General Assembly convened:

Age of children in preceding and subsequent sections changed to fourteen.

SECTION 1. Section 1753 of the general statutes is hereby amended by striking out in the first line of said section the word "thirteen" and inserting in lieu thereof the word "fourteen," so that said section as amended shall read as follows: No child under fourteen years of age shall be employed in any mechanical, mercantile, or manufacturing establishment.

SEC. 2. Section 1754 of the general statutes is hereby

amended by striking out the word "thirteen" wherever it occurs therein and inserting in lieu thereof the word "fourteen."

SEC. 3. All acts and parts of acts inconsistent herewith are hereby repealed.

Approved, May 9, 1895.

Violation of preceding section.

SEC. 1754. Any person acting for himself, or as agent in any way whatever of any mechanical, mercantile, or manufacturing establishment who shall employ or authorize or permit to be employed in such establishment any child, in violation of the preceding section, shall be fined not more than sixty dollars, and every week of such illegal employment shall be a distinct offense, provided that no person shall be punished under this section for the employment of any child, when at the time of such employment the employer shall demand, and thereafter during such employment keep on file the certificate of any town clerk, or of the teacher of the school where such child last attended, stating that such child is more than thirteen years of age, or a like certificate of the parent or guardian of such child in such cases only where there is no record of the child's age in the office of the town clerk, and such child has not attended school in this state. Any parent or guardian who shall sign any certificate that his child or ward is more than thirteen years of age, when in fact such child or ward is under thirteen years of age, shall be fined not more than sixty dollars.

Holidays, etc.

SEC. 1862. The first day of January, the twenty-second day of February, the thirtieth day of May, the fourth day of July, and the twenty-fifth day of December, or whenever any of said days shall fall upon Sunday, the Monday next following such day, and any day appointed or recommended by the governor of this state or the president of the United States as a day of thanksgiving, fasting, or any religious observance shall, for all purposes regarding the presenting for payment or acceptance, and of the protesting and giving notice of the dishonor of bills of exchange, bank checks, and promissory notes, be treated as public holidays, and all such checks, bills, and notes otherwise presentable for acceptance or payment on any of said days shall be deemed to be presentable therefor on the secular or business day next preceding such holiday, and in case by reason of a public holiday falling upon Sunday, the following Monday is deemed such holiday, as hereinbefore provided, the same shall be presentable on the Saturday preceding.

ACTS OF 1889.

CHAPTER XX.

An Act establishing a Legal Holiday.

Be it enacted by the Senate and House of Representatives in General Assembly convened:

Labor day. The first Monday of September in each year shall be a legal holiday in this state, to be known and designated as labor day.

Approved, March 20, 1889.

ACTS OF 1895.

CHAPTER CCIX.

An Act establishing Lincoln Day.

Be it enacted by the Senate and House of Representatives in General Assembly convened:

Lincoln day. The fifteenth day of October in each year shall be a legal holiday in this state, to be designated and known as Lincoln Day.

Approved, July 9, 1895.

ACTS OF 1897.

CHAPTER CXV.

An Act establishing Lincoln Day.

Be it enacted by the Senate and House of Representatives in General Assembly convened:

Lincoln Day changed. SECTION 1. The twelfth day of February in each year shall hereafter be a legal holiday in this state, to be designated and known as Lincoln Day.

SEC. 2. Chapter CCIX of the public acts of 1895 is hereby repealed.

Approved, April 29, 1897.

Division of profits. SEC. 1935. Any corporation organized after May 31, 1886, under general or special laws, may, by its board of directors, distribute to the persons employed in its service, or to any of them, such portions of the profits of the business of the corporation as the board of directors may deem just and proper.

Corporations may distribute profits. SEC. 1936. Any corporation organized on or prior to May 31, 1886, may give to its board of directors the power to distribute to the persons employed in its service, or to any of them, such portions of the profit of the business of the corporation as said board may deem just and proper; provided such power is given by a major vote of all the shareholders, at a meeting warned for the purpose.

SEC. 2105. No child under fourteen years of age, who has resided in the United States nine months, shall be employed to labor, unless such child shall have attended a day school in which instruction had been regularly and thoroughly given in the branches of education required in the public schools during at least twelve weeks, or sixty full school days of the twelve months, next preceding any month in which such child shall be employed, nor unless six weeks of this attendance has been consecutive. Any person who shall employ a child contrary to the provisions of this section shall be fined not more than sixty dollars.

Employment of children under 14 years of age who have not attended school legal time.

ACTS OF 1899.

CHAPTER XLI.

An Act concerning Instruction and Employment of Children.

Be it enacted by the Senate and House of Representatives in General Assembly convened:

SECTION 1. Any person who shall employ any child under fourteen years of age during the hours while the school which such child should attend is in session, and any person who shall authorize or permit on premises under his control any such child to be so employed, shall be fined not more than twenty dollars for every week in which such child is so employed.

SEC. 2. Section 2105 of the general statutes is hereby repealed.

Approved, April 5, 1899.

SEC. 2106. It shall be the duty of every parent, or other person having control of a child under fourteen years of age, to furnish the employer of such child a certificate signed by the teacher, school visitor, or committee of the school where the child attended, showing that the child has attended school as required by the preceding section. The employer of any such child shall require such certificate, shall keep it at his place of business during the time the child is in his employment, and shall show the same when demanded, during the usual business hours, to any school visitor of the town where the child is employed, or to the secretary or agent of the state board of education. Said certificate shall be evidence that the child has attended as the law requires.

Certificate of attendance to be given to employer by teacher of child under 14 years of age.

SEC. 2109. The selectmen, in every town, shall inspect the conduct of the heads of families, and if they find any who neglect the education of the children under their care, may admonish them to attend to their duty; and if they continue negligent, whereby the children grow rude, stubborn, and unruly,

Selectmen may bind out children negligently cared for at home.

they shall, with the advice of a justice of the peace, take such children from those who have the charge of them, and bind them out to some proper master, or to some charitable institution or society incorporated in this state for the care and instruction of such children, males till twenty-one, and females till eighteen years of age, that they may be properly educated, and brought up in some lawful calling.

Appointment of inspector.

SEC. 2263. The governor shall, with the consent of the senate, within sixty days after the organization of the general assembly in January, 1889, and every two years thereafter, appoint an inspector of factories, who shall hold his office from the first day of the succeeding July for a term of two years, and until his successor is appointed and qualified. In case of vacancy in the office of inspector through death, resignation, inability, or removal, the governor shall fill the same in the manner above provided for the appointment of inspector; and the governor may remove the inspector for cause.

The above appointment by chap. 18 of the acts of 1897 must be made before the May 1st after the organization of the January session of the general assembly in each odd year.

Duties.

SEC. 2264. The inspector of factories shall, as often as practicable, carefully examine all buildings and places where machinery shall be used, and shall have authority to enter such buildings and places at all proper times for the purposes of such inspection. He shall, on or before the first day of December in each year, make a report to the governor of the condition, as respects safety to life and health, of the factories, buildings, and places visited by him, and such report shall be printed for the use of the general assembly at each of its regular sessions.

ACTS OF 1897.

CHAPTER CLXXIV.

An Act concerning the Manufacture of Food from Flour and Meal.

Be it enacted by the Senate and House of Representatives in General Assembly convened:

Bake-shop law.

SECTION 1. Every building, room, or place, used in or in connection with the manufacture for sale of any article of food composed wholly or in part of flour or meal from cereals, shall be known under this act as a "bakeshop."

SEC. 2. Every bakeshop shall be properly drained, plumbed, ventilated, and kept in a clean and sanitary condition, and conducted with proper regard to the health of the operatives and the production of wholesome food.

SEC. 3. Every bakeshop shall be provided with a proper washroom and water-closet or closets, apart from the bakeroom or rooms where the manufacturing of such food products is conducted, and no water-closet, earth closet, or privy shall be within the bakeroom of any bakery.

SEC. 4. The sleeping places for persons employed in a bakeshop shall be kept separate from the room or rooms where flour or meal food products are manufactured or stored.

SEC. 5. The factory inspector shall examine all bakeshops as frequently as may be necessary, to ascertain whether they are kept and conducted in the manner herein provided; and shall, in addition to such regulation as the factory inspector is by law now authorized to make, report in writing to the local health officer of any town, city, or borough, every bakeshop located within such jurisdiction found not kept and conducted as herein provided; and such health officer shall thereupon investigate, or cause to be investigated by other health officer or officers, such unsanitary conditions so reported to him, and if found to exist, shall cause the same to be removed in the manner now provided by the laws relating to public health, as provided in section 2592 of the general statutes.

Approved, May 25, 1897.

ACTS OF 1899.

CHAPTER CXL.

An Act concerning the Manufacture of Food from Flour and Meal.

Be it enacted by the Senate and House of Representatives in General Assembly convened:

SECTION 1. Section two of chapter CLXXIV of the public acts of 1897 is hereby amended to read as follows: Every owner of a building or buildings occupied as a bakeshop shall cause the same to be properly drained, plumbed, lighted, and ventilated, and the occupant, tenant, or lessee of any bakeshop shall cause the same to be kept in a clean and sanitary condition, and conducted with proper regard to the health of the operatives and the production of wholesome food. No cellar not now used as a bakery shall be hereafter used and occupied as a bakery, and a cellar heretofore so used and occupied shall, when once closed, not be reopened for the purpose of use as a bakery. Every room hereafter used for the manufacture of flour or meal food shall be at least eight feet in height. *Sanitary provisions as to bake-shops.*

SEC. 2. The word cellar as used in this act shall be construed to mean any room wholly or in part underground, except such rooms or basements as shall, in the judgment of the in- *Word "cellar" defined.*

spector of factories, be properly drained, plumbed, lighted, and ventilated.

SEC. 3. This act shall take effect from its passage.

Approved, May 31, 1899.

Factories must be ventilated and kept clean.

SEC. 2265. All factories and buildings where machinery shall be used shall be well ventilated, and kept as clean as the nature of the business will permit. The belting, shafting, gearing, machinery, and drums of all factories and buildings where machinery shall be used, when so placed as in the opinion of the inspector to be dangerous to persons employed therein while engaged in their ordinary duties, shall, as far as practicable, be securely guarded. No machinery other than steam engines in a factory shall be cleaned while running, after notice forbidding the same is given by the inspector to the owners or operators of the factory.

ACTS OF 1899.

CHAPTER CXCIX.

An Act concerning Workshops and Providing for Inspection of the Same.

Be it enacted by the Senate and House of Representatives in General Assembly convened:

Inspection by inspector of factories.

SECTION 1. The inspector of factories shall, as often as practicable, carefully examine all buildings, apartments, rooms, and places in any tenement or dwelling house used for residential purposes and used in whole or in part other than by the immediate members of the family therein, for the manufacture of coats, vests, trousers, knee pants, overalls, cloaks, skirts, shirts, ladies' waists, artificial flowers, purses, cigars, cigarettes, or any articles of wearing apparel intended for sale.

Inspector of factories to be notified of location of workshops.

SEC. 2. It shall be the duty of persons engaged in the manufacture of such goods in such premises within thirty days after beginning such manufacture, and, in cases where persons are now engaged in such manufacture in such premises, within thirty days after the taking effect of this act, to notify said inspector of the location of said workroom or workrooms, the nature of the work there carried on, and the number of persons therein employed.

Workrooms to be kept clean and in a sanitary condition.

SEC. 3. It shall be the duty of the person operating said workroom or workrooms to keep the same at all times in a thoroughly clean and sanitary condition, and to have the same properly lighted and ventilated and fit for the occupancy of the persons engaged in work therein.

Powers of inspector and deputies.

SEC. 4. The inspector or any of his deputies shall notify the owner or owners of such premises, and the person using the

same for the purposes set forth in section one of this act, in the manner provided in section 2270 of the general statutes, to provide or cause to be provided ample means for lighting or ventilating such workroom or workrooms, and to put the same in a thoroughly clean, sanitary, and fit condition for occupancy for said work, and, if said notification be not complied with in thirty days after the service of such notice, said inspector or any of his deputies shall cause complaint to be made to any grand juror or prosecuting officer of the city, borough, or town in which such workroom or workrooms are located, to the end that violators of the provisions of this act may be prosecuted.

Penalty.

SEC. 5. Any person, firm, or corporation owning, using, or occupying any workroom or workrooms used for the purposes specified in section one of this act shall, for any violation of the provisions of this act, be fined not more than five hundred dollars.

Expense, how paid.

SEC. 6. The expense incurred by the inspector of factories or any of his deputies, while in the performance of their duties under this act, shall, together with the services of the deputies under this act, be paid by the comptroller, on approval of the inspector of factories.

SEC. 7. This act shall take effect on and after the first day of July, 1899.

Approved, June 20, 1899.

Elevators, wells, hoistways, etc., to be kept safe.

SEC. 2266. The inspector may order the opening of all hoistways, hatchways, elevator wells, and wheel holes upon any floor of any factory or other building where machinery shall be used, to be protected by good trap-doors, self-closing hatches, and safety catches, or other safeguards such as will insure the safety of the employes in such factory or other building where machinery shall be used, and all due diligence shall be used to keep such trap-doors closed at all times, except when in actual use by an occupant of the building having the use and control of the same.

ACTS OF 1893.

CHAPTER CXVIII.

An Act concerning Elevators.

Be it enacted by the Senate and House of Representatives in General Assembly convened:

Hoistways, elevator-wells, etc., to be kept safe.

Section 2266 of the general statutes is hereby amended to read as follows: The inspector of factories may order the opening of all hoistways, hatchways, elevator wells, and well

holes, upon every floor of every factory, mercantile establishment, or other building where machinery shall be used, to be protected by good trap-doors, self-closing hatches, and safety catches or other safeguards, such as will ensure the safety of the employes in such factory, mercantile establishment, or other building where machinery shall be used, and all due diligence shall be used to keep such trap-doors closed at all times, except when in actual use by an occupant of the building having the use and control of the same. All elevator cabs or cars, whether used for freight or passengers, shall be provided with some suitable mechanical device, if considered necessary by the said inspector, whereby the cab or car shall be securely held in the event of accident to the shipper-rope or hoisting machinery, or from any similar cause, and said mechanical device shall at all times be kept in good working order.

Elevator car to be provided with device for holding it in case of accident.

Approved, May 18, 1893.

Water-closets.

SEC. 2267. Every person or corporation managing or operating any factory, or owning or controlling the use of any other building where more than five persons are employed at labor, shall provide suitable water-closet accommodations for the use of the persons employed, and shall keep the same in good sanitary condition.

Notice and complaint by inspector.

SEC. 2268. It shall be the duty of the inspector to enforce the provisions of this chapter by giving proper orders or notice to the persons or corporations owning, operating, or managing the factories or buildings inspected by him, and also to make complaint to the state's attorneys in the several counties respectively of all violations of this chapter.

Penalty for violation of provisions of this title.

SEC. 2269. Any person, firm, or corporation being the owner, lessee, or occupant of any factory or building included within the provision of this chapter, or owning or controlling the use of any room in such building, shall, for a violation of any provision of sections 2265, 2266, or 2267, forfeit to the use of the state not less than fifty nor more than five hundred dollars, and shall also be liable to any employe for all damages suffered by him by reason of such violation. It shall be the duty of the state's attorneys in the several counties to collect forfeitures under this chapter, but no suit shall be brought for any such violation, either in behalf of any person or the state, until four weeks after notice has been given by the inspector to such person, firm, or corporation of any changes necessary to be made to comply with the provisions of said sections, and not then, if, in the meantime, such changes have been made in

accordance with such notifications. Nothing hereinafter shall be construed as limiting in any way the right of a person injured to bring an action to recover damages for the same, as though this chapter had not been enacted.

ACTS OF 1889.

CHAPTER CCXXV.

An Act relating to Factories.

Be it enacted by the Senate and House of Representatives in General Assembly convened:

Section 2269 of the general statutes is hereby amended by inserting between the word "sections" and the figures "2265" in the fifth line thereof, the figures "2264," so that the first sentence of said section as amended shall read as follows: Any person, firm, or corporation being the owner, lessee, or occupant of any factory or building included within the provisions of this chapter, or owning or controlling the use of any room in such building, shall, for a violation of any provision of sections 2264, 2265, 2266, 2267, forfeit to the use of the state not less than fifty nor more than five hundred dollars, and shall also be liable to any employe for all damages suffered by him by reason of such violation. *A correction.*

Approved, June 19, 1889.

ACTS OF 1893.

CHAPTER CCIV.

An Act for the Preservation of the Health of Factory Employes.

Be it enacted by the Senate and House of Representatives in General Assembly convened:

SECTION 1. Whenever the inspector of factories, on complaint of any person, after due investigation, shall find it necessary for the preservation of the health of the employes in any manufacturing establishment, factory, or mill in which is carried on the business of buffing, polishing, or grinding metals, or any operations in which an excessive amount of dust is generated, that the excessive dust resulting from said operations should be removed from the atmosphere of the rooms or apartments used for that purpose, he shall, in writing, direct the person or persons or corporation owning or occupying said premises, or carrying on business in such premises, within three months from the date of said order, to introduce and operate such appliances or devices as may be necessary to remove, so far as the nature of the business will permit, such excessive dust or foreign matter from the atmosphere of such mill, factory, or *Preservation of health of employe in factory by removal of excessive dust.*

apartment used for the purposes aforesaid; *provided*, such appliances or devices do not restrict or interfere with the aforesaid business or operations.

Penalty.

SEC. 2. Any violation of any proper order made or given by the inspector of factories, under the provisions of the preceding section, shall be punished in the manner provided in section 2269 of the general statutes.

Approved, June 14, 1893.

ACTS OF 1895.

CHAPTER CCVI.

An Act concerning Inspection of Factories.

Be it enacted by the Senate and House of Representatives in General Assembly convened:

Penalty for violating laws concerning factories and orders of the inspector of factories.

SECTION 1. Section 2269 of the general statutes is hereby amended to read as follows: Any person, firm, or corporation, being the owner, lessee, or occupant of any factory or building included within the provisions of this chapter, or owning or controlling the use of any room in such building, shall, for any violation of sections 2265, 2266, or 2267 of the general statutes, or for obstructing or hindering the inspector of factories in carrying out the duties of his office, forfeit to the use of the state not more than fifty dollars. It shall be the duty of the state's attorneys in the several counties to collect forfeitures under this chapter, but no suit shall be brought under any such violation until four weeks after notice has been given by the inspector to such person, firm, or corporation of any changes necessary to be made to comply with the provisions of said sections, and not then, if, in the meantime, such changes have been made in accordance with such notification. Nothing herein shall be construed as limiting in any way the right of a person injured to bring an action to recover damages for the same, as though this chapter had not been enacted.

Appeal.

SEC. 2. Any person, firm, or corporation aggrieved by any order of an inspector of factories may appeal to the superior court in the county where the person, firm, or corporation owns, leases, or occupies the factory or building in relation to which said order relates, within four weeks after notice of such order shall be given. Said appeal shall operate as a supersedeas, shall be made in writing, and shall contain a brief statement of the facts and reasons of appeal and a citation to the inspector of factories to appear before said court, and said court or any judge thereof may direct the time of appearance and the manner of service. Said court may review the doings of the factory inspector, may examine the questions in issue, and may confirm, change, or set aside the doings of the factory

inspector, and may make such orders in the premises, including orders as to costs, as it may find to be proper and equitable.

SEC. 3. All acts and parts of acts inconsistent herewith are hereby repealed.

Approved, July 9, 1895.

Character and service of notices.

SEC. 2270. The orders and notices given by the inspector under this chapter shall be written or printed, and signed by him officially, and may be served by himself or any proper officer or indifferent person, by leaving an attested copy thereof with or at the usual place of abode of the person upon whom the service is to be made; and the notice, properly indorsed with the doings of the person or officer serving the same, shall be returned to the office of the town clerk of the town in which is located the factory, building, or business to which such appertains, where it shall be kept on file. Such notice and copies thereof duly certified by the town clerk, shall be *prima facie* evidence that notice was given as therein appears. Notice to one member of a firm shall be notice to every member thereof, and notice to the president, secretary, or treasurer of a corporation shall be notice to such corporation. The fees for serving such orders and notices, unless served by the inspector, shall be included in the necessary expenses of the inspector and paid by the state.

Inspector to have office at Capitol, records etc.

SEC. 2271. It shall be the duty of the comptroller to provide suitable rooms in the capitol at Hartford for the use of the inspector, and to furnish him blank forms for the purpose of giving notices and orders required by this chapter, and for annual reports to be made to the governor. The inspector shall keep in books provided by the comptroller for that purpose, copies of all notices and orders given by him, and a record of all inspections and examinations made, and upon the expiration of his term of office shall file his books of records with the secretary of state.

Special agents and their compensation.

SEC. 2272. The inspector may from time to time employ special agents to assist him in his inspections and examinations, who shall receive compensation for the time actually employed in such service only. The total amount to be expended under this section shall not exceed in any one year the sum of fifteen hundred dollars, which shall be paid by the state upon the proper vouchers by the special agents, which shall be signed by the inspector.

ACTS OF 1893.

CHAPTER CCVI.

An Act relating to Duties of the Inspector of Factories.

Be it enacted by the Senate and House of Representatives in General Assembly convened:

Special agents to assist inspector of factories.

SECTION 2272 of the general statutes is hereby amended to read as follows: The inspector may from time to time employ special agents to assist him in the performance of the duties of his office. Such special agents while so employed shall have the same power and authority as the inspector, subject to his approval. The total amount expended under this section shall not exceed in any one year the sum of three thousand dollars, which shall be paid in the same manner as the expenses of other departments of the state government, upon proper vouchers by the special agents, signed by the inspector.

Limitation of expense.

Approved, June 14, 1893.

CHAPTER CLVIII.

An Act concerning Fire Escapes.

Be it enacted by the Senate and House of Representatives in General Assembly convened:

Certain buildings to be provided with fire escapes.

SEC. 2645. Every story above the second story, not including the basement, in any workshop, manufactory, hotel, building occupied on such story as an assembly or lodge-room by any literary, benevolent, or other society, boarding-house accommodating more than twelve lodgers, or tenement house arranged for or occupied by more than five families, shall be provided with more than one way of egress, by stairways on the inside or fire escapes on the outside of the building, and such stairways and fire escapes shall be kept free from obstruction and shall be accessible from each room in said story.

ACTS OF 1889.

CHAPTER CLIV.

An Act amending an Act concerning Fire Escapes.

Be it enacted by the Senate and House of Representatives in General Assembly convened:

Concerning fire escapes in tenements.

SECTION 1. Section 2645 of the general statutes is hereby amended by striking out the word "five" between the words "than" and "families" in the clause "or tenement house arranged or occupied by more than five families," and inserting the word "two" in place thereof.

SEC. 2. This act shall take effect upon its passage.

Approved, May 21, 1889.

ACTS OF 1893.

CHAPTER XXIV.

An Act concerning Fire Escapes in Hotels.

Be it enacted by the Senate and House of Representatives in General Assembly convened:

Hotels to be furnished with appliances for fire escape.

SECTION 1. Every owner, lessee, proprietor, or manager of a hotel situated in this state shall, on or before the first day of January in the year 1894, place or caused to be placed a knotted rope or other better appliance, for use as a fire escape, in every room of said hotel used as a lodging room, except rooms on the ground floor; which knotted rope or other better appliance shall be securely fastened to a suitable iron hook or eye, to be securely screwed into one of the joists or timbers next adjoining the frame of the window, or one of the windows, of said room at least five feet from the floor, which rope shall be at all times kept coiled and exposed to the plain view of any occupant of said room; the coil to be fastened in such manner as to be easily and quickly loosened and uncoiled; such rope shall contain knots not more than eighteen inches apart, and a loop on the end, at least three inches in length, and shall not be less than one-half inch in diameter, and of sufficient length to reach from the window to the ground. Such rope, iron hook, or eye and fastenings shall be of sufficient strength to sustain a weight of four hundred pounds, and there shall be plain directions how to use such rope or other better appliance printed and posted within six inches of the hook or eye to which the rope is fastened.

Officers charged with duty of inspection.

SEC. 2. It shall be the duty of the inspector of buildings of every city or town in the state, or, if there be no such officer, of the chief engineer, or the officer performing the duty of chief engineer of the fire department, or if there be neither of such officers, then of the first selectman of every town in the state, in the month of July of each year to inspect every room of every hotel in the city or town in which he is performing the duty of inspector of buildings or of chief engineer or selectman, and to ascertain if the provisions of this act are complied with, and to report the condition of the rope or other better appliance to the mayor of the city or the board of selectmen of the town.

Their report.

Penalty for violating this act.

SEC. 3. Any person violating any of the provisions of this act shall be guilty of a misdemeanor, and punishable by a fine of not more than five hundred dollars, or imprisonment in the county jail for not more than six months, or by both such fine and imprisonment.

Approved, March 29, 1893.

ACTS OF 1895.

CHAPTER CCLIV.

An Act concerning Fire Escapes.

Be it enacted by the Senate and House of Representatives in General Assembly convened:

Fire escapes must be provided certain buildings.

SECTION 1. Every story above the first story of any building used or occupied as a schoolhouse, orphan asylum, insane asylum, reformatory of any kind, opera house, hall rented or used for public assemblies of any kind, boarding house accommodating more than twelve persons, or tenement house occupied by more than five families, shall be provided with more than one way of egress, by stairways on the inside or fire escapes on the outside of such building. And said stairways and fire escapes shall, at all times, be kept free from obstruction, and shall be accessible from each room in every story above the first story.

Amended by Chapter CCCXLVI of acts of 1895.

SEC. 2. If any of the above-named buildings, or any workshop, manufactory, hotel, boarding house, tenement house, or other building used, in whole or in part, for any of the purposes above specified, or in which more than twenty persons shall be employed above the first story, shall be more than two stories in height, it shall be provided with at least one fire escape, of iron or other incombustible material, on the outside of said building, and if such building shall be more than one hundred and fifty feet in length, then it shall be provided with one such fire escape for every one hundred and fifty feet, or fractional part thereof exceeding fifty feet in length of such building; and such fire escapes shall be conveniently accessible from each story of said building.

Penalty if owner neglect to provide fire escapes.

SEC. 3. It shall be the duty of the owner of every such building to provide such fire escapes and means of egress, or cause the same to be provided, and if he shall neglect so to do, for a period of three months after the passage of this act, or for a period of three months after notice so to do from the building inspector or other proper authority, he shall, on conviction thereof, be fined not more than five hundred dollars, or imprisoned not more than six months, or both.

Duties of building inspectors, wardens, and selectmen.

SEC. 4. It shall be the duty of the building inspector of each city, the warden of each borough, and the first selectman of each town not having a building inspector, either by himself or by some proper person appointed by him, to inspect all of the above-named buildings at least once each year between April first and October first, and see that the provisions of this act are complied with; and for such purpose he shall have the right to enter any of said buildings in the daytime, between the hours of nine and five o'clock. And said city, borough, or

town shall fix and pay the compensation for all services under the provisions of this act.

SEC. 5. This act shall not impair or affect the provisions of Chapter XXIV of the public acts of 1893 concerning fire escapes in hotels.

SEC. 6. Sections 2645, 2646, and 2647 of the general statutes, and Chapter CLIV of the public acts of 1889, and Chapter CV of the public acts of 1893, are hereby repealed.

Approved, June 29, 1895.

ACTS OF 1895.

CHAPTER CCCXLVI.

An Act amending an Act concerning Fires Escapes.

Be it enacted by the Senate and House of Representatives in General Assembly convened:

Building inspector to judge as to necessity of fire escape.

Section two of chapter CCLIV of the acts of this assembly, approved June 29, 1895, is hereby amended by inserting after the word "building," where it occurs the second time in said section, the words, "unless it shall be made to appear to the building inspector or other proper authority, as provided in section four of this act, that said building is already supplied with a sufficient number of safe and proper means of egress."

Approved, July 9, 1895.

Examination of such buildings to be made by certain officers.

SEC. 2646. It shall be the duty of the first selectman of the town, or the fire marshal of the city, or the warden of the borough in which any such building is situated, to examine all buildings referred to in the preceding section, and if on examination he finds that such building is provided with fire escapes or stairways, as required by said section, he shall furnish the owner thereof with a certificate to that effect, in which case such owner shall not be liable.

Penalty for violation of two preceding sections.

SEC. 2647. Every owner of such building who shall violate any of the provisions of the two preceding sections shall be fined fifty dollars.

Bureau of Labor Statistics.

SEC. 2944. There shall continue to be a bureau of labor statistics, to be under the control and management of the commissioner thereof, to be appointed as hereinafter provided.

Commissioner; appointment, tenure, vacancy, removal.

SEC. 2945. The governor shall, with the consent of the senate, within sixty days after the organization of the general assembly in January, 1891, and every four years thereafter, appoint a commissioner of said bureau who shall hold his office

from the first day of the succeeding July, for a term of four years, and until his successor is appointed and qualified. In case of vacancy in the office of commissioner, through death, resignation, inability, or removal, the governor shall fill the same until filled in the manner above provided for the appointment of commissioner; and the governor may remove the commissioner for cause.

ACTS OF 1897.

CHAPTER XVIII.

An Act concerning Executive Nominations and Appointments.

Be it enacted by the Senate and House of Representatives in General Assembly convened:

Time of appointment changed to May 1st.

SECTION 1. All nominations and appointments made by the governor, requiring the consent of the senate or of the general assembly, shall be made on or before May first of the year in which the general assembly is in session.

SEC. 2. All acts inconsistent herewith are hereby repealed.

SEC. 3. This act shall take effect from its passage.

Approved, March 4, 1897.

ACTS OF 1889.

CHAPTER CLXXVII.

An Act concerning the Bureau of Labor Statistics.

Be it enacted by the Senate and House of Representatives in General Assembly convened:

Salaries and expenses.

Section 3706 of the general statutes is hereby amended in the clause relating to the commissioner of the bureau of labor statistics so as to read as follows: The commissioner of the bureau of labor statistics, three thousand dollars and the necessary postage, stationery, and office expenses of said bureau, and the traveling expenses of the commissioner and his assistants, incurred in the performance of the duties of his office, shall be audited by the comptroller and paid in the same manner as the expenses of other departments of the state government.

Approved, June 5, 1889.

ACTS OF 1899.

CHAPTER 197.

An Act amending an Act concerning the Salary of the Commissioner of the Bureau of Labor Statistics.

Be it enacted by the Senate and House of Representatives in General Assembly convened:

SECTION 1. Section 3706 of the general statutes is hereby

amended so that the paragraph in said section relating to the salary of the commissioner of the bureau of labor statistics shall read as follows: The commissioner of the bureau of labor statistics, two thousand five hundred dollars and the necessary postage, stationery, and office expenses of said bureau, and the traveling expenses of the commissioner and his assistants, incurred in the performance of the duties of his office, shall be audited by the comptroller and paid in the same manner as the expenses of other departments of the state government. *Salaries and expenses.*

SEC. 2. Chapter clxxvii of the public acts of 1889 is hereby repealed.

SEC. 3. This act shall take effect July 1, 1899.

Approved, June 15, 1899.

SEC. 2946. The comptroller shall provide suitable rooms in the capitol at Hartford for the use of said bureau. The commissioner may appoint and remove at pleasure one clerk of said bureau, who shall receive the same compensation as the chief clerk of the board of railroad commissioners. *Rooms; clerk, compensation.*

SEC. 2947. The commissioner shall collect information upon the subject of labor, its relation to capital, the hours of labor, and the earnings of laboring men and women, and the means of promoting their material, social, intellectual, and moral prosperity, but for this purpose persons shall not be required to leave the vicinity of their residence or places of business. *Duties of commissioner.*

SEC. 2948. The commissioner shall report to the governor, on or before the first day of December in each year, all the statistical details relating to the business of his department. *Report.*

SEC. 2949. The commissioner may employ from time to time special agents to assist him in his investigations, who shall receive compensation for the time actually employed in such service only, to be paid in the manner provided for other expenses of said bureau. *Employment and compensation of special agents.*

SEC. 3018. Every building in the construction or repairs of which, or of any of its appurtenances, any person shall have a claim for material furnished or services rendered exceeding twenty-five dollars in amount, by virtue of an agreement with, or by consent of, the owner of the land upon which the building is erected, or some person having authority from or rightfully acting for such owner in procuring or furnish- *Mechanics' lien on buildings.*

ing such labor or materials, shall, with the land on which the same may stand, be subject to the payment of such claim; and said claim shall be a lien on such land, building, and appurtenances, and shall take precedence of any incumbrance originating after the commencement of such services or the furnishing of any materials, subject to apportionment, as provided in section 3021; and said premises may be foreclosed by such person, in the same manner as if held by mortgage.

ACTS OF 1895.

CHAPTER L.

An Act concerning Mechanics' Liens.

Be it enacted by the Senate and House of Representatives in General Assembly convened:

Dissolution of mechanics' lien by substitution of bond.

SECTION 1. Whenever any mechanics' lien shall have been placed upon any real estate pursuant to sections 3018, 3019, and 3020 of the general statutes, the owner of such real estate, or any person interested therein, may make an application to any judge of the superior court, court of common pleas, or district court, that said lien be dissolved upon the substitution of a bond with surety, and such judge shall order reasonable notice to be given to the lienor of such application. If such lienor shall be a non-resident of the state, such judge may order notice to be given by publication, registered letter, or personal service. If such judge shall be satisfied that the applicant in good faith intends to contest such lien, he shall, if the applicant offer a bond, with sufficient surety, conditioned to pay to the lienor or his assigns such amount as a court of competent jurisdiction may adjudge to have been secured by said lien, with interest and costs, order said lien to be dissolved and such bond substituted therefor, and shall return such application, notice, order, and bond to the clerk of the superior court for the county wherein such lien is recorded; and if the applicant, within ten days from such return, shall cause a copy of said order, certified by said clerk, to be recorded in the town clerk's office where such lien is recorded, such lien shall be dissolved.

Action upon bond.

SEC. 2. Whenever a bond shall be substituted for any lien, after an action for the foreclosure of a lien has been commenced, the plaintiff in such foreclosure may amend his complaint without costs, so as to make the action one upon such bond.

Dissolution.

SEC. 3. Whenever a bond shall have been substituted for any lien, pursuant to this act, unless an action shall be brought to recover upon such bond within two years from the date of recording the certificate of lien, such bond shall be void.

Approved, April 3, 1895.

ACTS OF 1895.

CHAPTER CXLIII.

An Act concerning Mechanics' Liens.

Be it enacted by the Senate and House of Representatives in General Assembly convened:

SECTION 1. Section 3018 of the general statutes is hereby amended by striking out in the third line the word "twenty-five" and inserting in lieu thereof the word "ten" so that said section, as amended, shall read as follows: Every building, in the construction or repairs of which, or of any of its appurtenances, any person shall have a claim for materials furnished or services rendered exceeding ten dollars in amount, by virtue of an agreement with or by consent of the owner of the land upon which such building is erected, or some person having authority from or rightfully acting for such owner in procuring or furnishing such labor or materials, shall, with the land on which the same may stand, be subject to the payment of such claim; and said claim shall be a lien on such land, building, and appurtenances, and shall take precedence of any other incumbrance originating after the commencement of such services, or the furnishing of any such materials, subject to apportionment, as provided in section 3021; and said premises may be foreclosed by such person in the same manner as if held by mortgage.

Mechanics' lien for labor or building materials

Precedence.

SEC. 2. All acts and parts of acts inconsistent herewith are hereby repealed.

Approved, May 23, 1895.

ACTS OF 1897.

CHAPTER LIV.

An Act concerning Mechanics' Liens.

Be it enacted by the Senate and House of Representatives in General Assembly convened:

SECTION 1. Section 3018 of the general statutes, as amended by chapter CXLIII of the public acts of 1895, is hereby amended to read as follows: Every building in the construction, raising, removal, or repairs of which, or any of its appurtenances, any person shall have a claim for materials furnished or services rendered exceeding ten dollars in amount, by virtue of an agreement with or by the consent of the owner of the land upon which such building is erected, or has been moved, or some person having authority from or rightfully acting for such owner in procuring or furnishing such labor or materials shall, with the land on which the same may stand,

Mechanics' lien for labor or building material.

be subject to the payment of such claim; and said claim shall be a lien on such land, building, and appurtenances, and shall take precedence of any other incumbrance originating after the commencement of such services, or the furnishing of any such materials, subject to apportionment as provided in section 3021; but in the case of removal no such lien shall take precedence of any incumbrance upon the land to which the building is removed which accrued before the building has been actually moved upon the land; and said premises may be foreclosed by such person in the same manner as if held by mortgage.

SEC. 2. All acts and parts of acts inconsistent herewith are hereby repealed.

Approved, March 31, 1897.

Certificate of lien to be recorded.

SEC. 3019. No such lien shall be valid, unless within sixty days after the person performing such service or furnishing such materials has ceased so to do, he shall lodge with the town clerk of the town in which said building is situated a certificate in writing describing the premises, the amount claimed as a lien thereof, and the date of the commencement of the claim the same being first subscribed and sworn to as the amount justly due, as nearly as the same can be ascertained, which certificate shall be recorded by the town clerk with deeds of land; but in case of the death of a party who might have filed such a certificate before filing the same, his executor or administrator may make and lodge such a certificate within three months from the time of his qualification as such, and within six months from the decease of the original claimant.

See also amendments to section 3018.

Notice to owner or his agent that lien is claimed.

Sub-contractor's lien.

SEC. 3020. No person other than the original contractor for the building, or a sub-contractor, whose contract with such original contractor is in writing, and has been assented to, in writing, by the other party to such original contract, shall be entitled to claim any such lien, unless he shall, within sixty days from the time he shall have commenced to furnish materials, or render services, give written notice to the owner of such building, that he has so commenced to furnish materials or render services, and intends to claim a lien therefor on said building; which shall be served upon said owner, if he resides in the same town in which said building is being erected or repaired by any indifferent person, by leaving with him, or at his usual place of abode, a true and attested copy thereof; and if such owner does not reside in said town, but has a known agent therein, such notice may be so served upon said agent, otherwise it may be served by any indifferent person, by de-

positing in the post-office, in the town in which the claimant resides, postage paid, a true and attested copy of said notice, directed to such owner at the place where he resides; and where there shall be two or more owners, notice to one of them, if given as provided in this section, shall be deemed notice to all; and a copy of said notice, and of the return of the person who served it, indorsed thereon, shall also be lodged for record with the town clerk of the town in which such land lies within said period of sixty days. No sub-contractor, with or without a written contract complying with the provisions of this section, shall be required to obtain an agreement with, or the consent of, the owner of land, as provided in section 3018, to enable him to claim a lien under this section.

See also amendments to section 3018.

ACTS OF 1899.

CHAPTER CXXI.

An Act concerning Mechanics' Liens.

Be it enacted by the Senate and House of Representatives in General Assembly convened:

SECTION 1. Section 3020 of the general statutes is hereby amended to read as follows: No other person than the original contractor for the construction, raising, removal, or repairing of the building, or a sub-contractor, whose contract with such original contractor is in writing, and has been assented to, in writing, by the other party to such original contract, shall be entitled to claim any such lien, unless he shall, within sixty days from the time he shall have ceased to furnish materials or render services for such construction, raising, removal, or repairing, give written notice to the owner of such building that he has so commenced to furnish materials or render services, and intends to claim a lien therefor on said building; which shall be served upon said owner, if he resides in the same town in which said building is being erected, raised, removed, or repaired, by any indifferent person, by leaving with him or at his usual place of abode a true and attested copy thereof; and if said owner does not reside in said town, but has a known agent therein, such notice may be so served upon said agent, otherwise it may be served by any indifferent person, by depositing in the post-office, in the town in which the claimant resides, postage paid, a true and attested copy of said notice, directed to such owner at the place where he resides; and where there shall be two or more owners, notice to one of them, if given as provided in this section, shall be deemed notice to all; and a copy of said notice, and of the return of the person who served it, indorsed thereon, shall be returned to the

Notice to owner or his agent that lien is claimed.

Sub-contractor's lien.

original maker thereof within said period of sixty days. No sub-contractor, with or without a written contract complying with the provisions of this section, and no person who furnishes material or renders services by virtue of a contract with the original contractor, or with any sub-contractor, shall be required to obtain an agreement, with or the consent of, the owner of the land, as provided in section 3018, to enable him to claim a lien under this section.

Lien not to exceed, in the whole, the contract price for the building.

SEC. 2. Section 3021 of the general statutes is hereby amended to read as follows: No such lien shall attach to any building or its appurtenances, or to the land on which the same may stand, in favor of any person, to a greater amount in the whole than the price which the owner agreed to pay for such building and its appurtenances; and when there shall be serveral claimants, and the amount of their united claims shall exceed such price, the claimants, other than the original contractor, shall be entitled to be first paid in full, if the amount of such price is sufficient for that purpose; but if not, it shall be apportioned among the claimants having such liens, other than the original contractor, in proportion to the amount of the debts due them respectively; and the court having jurisdiction thereof, on application of any person interested, may direct the manner in which such claims shall be paid; but in determining the amount to which any lien or liens shall attach upon any land or building, the owner of such land or building shall be allowed whatever payments he shall have made, in good faith, to the original contractor or contractors, before receiving notice of such lien or liens. No payments made in advance of the time stipulated in the original contract shall be considered as made in good faith, unless notice of intention to make such payment shall have been given in writing to each person known to have furnished materials or rendered services at least five days before such payment is made.

SEC. 3. All acts and parts of acts inconsistent herewith are hereby repealed.

Approved, May 19, 1899.

Liens not to exceed in the whole the contract price for the building.

SEC. 3021. No such lien shall attach to any building or its appurtenances, or to the land on which the same may stand, in favor of any person, to a greater amount in the whole, than the price which the owner agreed to pay for such building and its appurtenances; and when there shall be several claimants, and the amount of their united claims shall exceed such price, the claimants, other than the original contractor, shall be entitled to be first paid in full, if the amount of such price is sufficient for that purpose; but if not, it shall be apportioned among the claimants having such liens, other than the original contractor,

in proportion to the amount of the debts due them, respectively, by the original contractor; and the court having jurisdiction thereof, on application of any person interested, may direct the manner in which such claims shall be paid; but in determining the amount to which any lien or liens shall attach upon any land or building, the owner of such land or building shall be allowed whatever payments he shall have made, in good faith, to the original contractor or contractors, before receiving notice of such lien or liens.

See also amendments to section 3021.

Lien on railroad for services or materials furnished for its construction

SEC. 3022. Every railroad, for the construction of which, or any of its appurtenances, any person shall have a claim for materials furnished or services rendered, under any contract with or approved by the corporation owning or managing such railroad, shall with its real estate, right of way, material, equipment, rolling stock, and franchise, be subject to the payment of such claim; and said claim shall be a lien on said railroad, railroad property, and franchise, and the manner of asserting and perfecting such lien, by notice, certificate, and foreclosure, shall be in all respects in accordance with the provisions of the four preceding sections; except that the certificates of the lien and of its discharge shall be filed in the office of the secretary of state, who shall record them in a book kept for that purpose.

Limitation of mechanic's lien

SEC. 3030. No mechanics' lien shall continue in force for a longer period than two years after such lien has been perfected, unless the party claiming such lien shall, within said period, commence an action to foreclose the same, and proceed therewith to final judgment; and every such lien after the expiration of two years without action commenced shall be discharged of record by the person claiming the same, upon the request of the owner of the property upon which the lien had been claimed.

Lien of material man on vessels.

SEC. 3041. Every vessel, in the construction or repairs of which, or of its appurtenances, any person shall have a claim for more than twenty dollars, for material furnished or services rendered shall be subject to a lien for the amount of such claim, which lien shall be on such vessel and its appurtenances, and shall take precedence of any other incumbrance (except a lien for mariners' wages,) which shall originate subsequent to the commencement of such services, or the furnishing of such materials, subject to apportionment as provided by section 3044, and may be foreclosed like a mortgage of personal property.

Certificate of lien to be lodged with the town clerk. Copy to be left with the owner or his agent.

SEC. 3042. No such claim shall remain a lien on such vessel or its appurtenances more than ten days after the person performing such services, or furnishing such materials, has ceased so to do, unless he shall sign and lodge with the town clerk of the town where such vessel was so constructed or repaired, a certificate in writing describing the kind of vessel, the amount claimed as a lien thereon, the place in the town where the services or materials were furnished, the date of the commencement of the claim, the name of the vessel, if known to him, and the name of the owner or owner's agent, if known to him; which certificate the town clerk shall record in a book kept by him for that purpose; nor unless such person shall also leave a copy of such certificate with the owner of said vessel, or his agent, if either of them are known to him to have a residence in this state.

Liens not to exceed in the whole the contract price for the vessel or its repairs.

SEC. 3044. No vessel or its appurtenances shall be subject to such liens for a greater amount in the whole than the price agreed to be paid for such vessel or its repairs; and when several liens shall be claimed by different persons to an amount in all exceeding such agreed price, the claimants other than the original contractor shall be entitled to be first paid in full, if such sum be sufficient for that purpose, but if it be not sufficient it shall be apportioned among the claimants, other than the original contractor, in proportion to the amount of their respective claims; and the court having jurisdiction thereof, on application of any person interested, may direct the manner in which such claims shall be paid.

Priority and apportionment in case of excess.

Liens of boarding or lodging-house keepers on baggage. 41 Conn., 184.

SEC. 3046. When a special agreement shall have been made between the keeper of any boarding or lodging-house, and any person boarding or lodging at such house, regarding the price of such board or lodging, all the baggage and effects kept by such person at such house, shall be subject to a lien in favor of the keeper of such house for all such sums as shall be at any time due him from such person for board or lodging; and such boarding-house or lodging-house keeper may detain such baggage and effects until such debt shall be paid; and if it be not paid within sixty days after it is due, he may sell said property, or such part thereof as shall be necessary, and apply the proceeds to the payment of such debt.

ACTS OF 1897.

CHAPTER C.

An Act concerning the Duties and Liabilities of Hotel Keepers.

Be it enacted by the Senate and House of Representatives in General Assembly convened:

Lien of hotel-keeper on baggage of boarder.

SEC. 3. Whenever the keeper of any hotel or inn shall receive into his hotel or inn any person as a boarder, he shall have a lien upon and right to detain the baggage and effects of such boarder to the same extent, and in the same manner as if such boarder had been received as a guest; and such lien may be enforced in the manner hereinafter provided.

Sale of baggage and property to pay board bill.

SEC. 4. At any time after thirty days after the person incurring any debt or obligation has left the hotel or inn wherein such debt or obligation was incurred and the debt or obligation being still due and unpaid, the proprietor of said hotel or inn may sell at public auction for cash at the office of said hotel or inn any or all baggage or property left at said hotel or inn, and apply the avails of said sale towards the payment of said debt or obligation; *provided*, that such sale shall be advertised in a newspaper published or having a circulation in the town where said hotel or inn is situated, three times, commencing at least five days before said sale; and that in case the last usual place of abode of said debtor is known to or can reasonably be ascertained by said hotel keeper that notice of the time and place of sale shall be given him by mailing such notice to him in a registered letter, postage paid, at such last usual place of abode at least five days before the time of sale.

Warden may employ convicts outside of prison.

SEC. 3343. The warden may, with the consent of the directors, employ the prisoners, not exceeding ten at a time, outside the prison walls, within one and a half miles thereof, under the charge of some proper officer of the prison. He shall provide for said prisoners suitable food and clothing and proper implements and materials for their work, and shall provide for the relief of any sick or infirm prisoner, and shall be paid for the same out of the earnings of said prisoners, if sufficient, and if not, by the state; shall superintend the labor and conduct of the prisoners; act as the general agent of the prison, in the purchases and sales thereof, which shall be for cash only; keep accurate accounts, render the same to the directors at their quarterly meetings, and when requested communicate to them any information in his knowldge respecting the prison, annually, in May, and oftener if required, settle his accounts with the comptroller or such other person as the general assembly may appoint; and may, in his own name as warden, sue on any contract made by him in the business of said prison.

CHAPTER CIII.

An Act concerning the Employment of Convicts in the Connecticut State Prison.

Be it enacted by the Senate and House of Representatives in General Assembly convened:

Warden may employ convicts outside of prison.

SECTION 1. Section 3343 of the general statutes is hereby amended to read as follows: The warden may employ such number of prisoners as may be approved by the board of directors outside the prison walls, within two miles thereof, under the charge of some proper officer of the prison. He shall provide for said prisoners suitable food and clothing, and proper implements and materials for their work, and shall provide for the relief of any sick or infirm prisoner, and shall be paid for the same out of the earnings of said prisoners, if sufficient, and if not, by the state; shall superintend the labor and conduct of the prisoners; shall act as the general agent of the prison, in the purchases and sales therefor, which shall be for cash only; shall keep accurate accounts, and render the same to the directors at their quarterly meetings, and, when requested, communicate to them any information in his knowledge respecting the prison; and annually, in May, or oftener if required, he shall settle his accounts with the comptroller; and may, in his own name, as warden, sue on any contract made by him in the business of said prison.

SEC. 2. This act shall take effect from its passage.

Approved, April 14, 1897.

Labor of convicts for costs.

SEC. 3348. Every prisoner, detained only for the payment of costs, shall be allowed for his labor customary journeyman's wages for like labor; but if, in the opinion of the directors, he shall be unable to pay said costs, and has conducted well during his confinement, the warden may accept the note of such prisoner, payable to the state, for the amount of such costs, and discharge him.

Labor of convicts to pay fines.

SEC. 3349. Every prisoner held in said prison (state prison) for non-payment of a fine, shall be allowed one hundred dollars a year for his labor, from the time when his imprisonment for the non-payment of said fine commenced, if, in the opinion of the warden and directors, he shall have been submissive to the officers of the prison during his confinement, and conducted himself as a faithful prisoner.

Employment of convicts regulated.

SEC. 3355. Whenever it shall be proposed to employ fifty or more of the prisoners confined in the state prison, by contract or otherwise, at any trade or occupation, the directors of

the state prison shall give public notice of the fact by advertising in one or more of the leading papers in each city and town of the state having over ten thousand inhabitants, not less than once each week for the period of four weeks before so employing said prisoner, and shall inquire into the effects of such purposed employment upon the interest of the state, the moral and physical condition of the prisoner and upon free labor; and said directors shall give a hearing to all who may wish to be heard in the matter, and if it shall appear upon such inquiry, that such proposed employment will not be for the interest of the state, or will be detrimental to the moral and physical condition of the prisoners, or will seriously injure the citizens of this or any other state engaged in this proposed trade or occupation, it shall be prohibited.

ACTS OF 1895.

CHAPTER CLIII.

An Act concerning the Employment of Convicts.

Be it enacted by the Senate and House of Representatives in General Assembly convened:

Convicts not to be employed at certain labor.

No person confined in any penitentiary, or other place for the confinement of offenders, under the control of the state, shall be employed in or about the manufacture or preparation of any drugs, medicines, food or food material, cigars or tobacco, or any preparation thereof, pipes, chewing-gum, or any other article or thing used for eating, drinking, chewing, or smoking, or for any other use within or through the mouth of any human being.

Approved, May 23, 1895.

Employment of prisoners in county jails.

SEC. 3365. The county commissioners may require all convicts to work according to their ability, permit other prisoners, if they desire it, to be provided with materials for work and employment, require the deputy jailer or deputy jailers, other officers and employes, to superintend the conduct and labor of the prisoners, prescribe rules for the management, government, discipline, and employment of the prisoners in the jails and jail buildings of their respective counties, and it shall be the duty of the respective sheriffs to enforce the same; and said commissioners shall visit the jails in their several counties at least once a month, examine into their management, and audit all accounts pertaining to the jails.

The above section was amended by chapter 153 of the acts of 1895 as follows: No person confined in any penitentiary, or other place for confinement of offenders, under the control of the state, shall be employed in or about the manufacture

Articles not to be made by convicts.

or preparation of any drugs, medicines, food or food material, cigars or tobacco, or any preparation thereof, pipes, chewing-gum, or any other article or thing used for eating, drinking, chewing, or smoking, or for any other use within or through the mouth of any human being.

Implements and materials for labor in county jails.

SEC. 3366. The deputy jailer or deputy jailers, under the rules and directions of the county commissioners, shall procure suitable food, clothing, and medical aid for prisoners committed on criminal process, and such implements and materials as shall be proper for employing and keeping such prisoners at work, and the accounts thereof shall be examined and audited by the county commissioners, and said commissioners shall draw their orders for the payment of the same upon the treasurers of their respective counties.

Workhouses and labor therein.

SEC. 3394. Any town may establish a workhouse and provide suitable buildings for the confinement of offenders sentenced thereto; furnish materials for their work, direct the kind of labor, and the manner and place in which it is to be performed, either in or out of the workhouse; and make any lawful regulations necessary to carry into effect the provisions of this chapter.

Labor in workhouses.

SEC. 3396. The master shall receive all persons lawfully sent there, and keep them employed in such labor as they shall be able to perform; and if any of them shall refuse to work in a proper manner, may put them in close confinement until they shall obey his orders, and in case of great obstinacy or perverseness, may reduce them to bread and water, until they shall be brought to obedience.

For further particulars regarding workhouses see General Statutes, Sections 3394-3412, and chapter xcvii of the Acts of 1893.

Security from contractors for paying laborers; liability of company therefor.

SEC. 3470. Every railroad company, in making contracts for the building of its roads, shall require sufficient security from the contractors for the payment of all labor thereafter performed in constructing the road by persons in their employ; and the company shall be liable to the laborers employed for labor actually performed on the road, if they, within twenty days after the completion of such labor, shall, in writing, notify its treasurer that they have not been paid by the contractors.

Railroad trains on Sunday restricted.

SEC. 3523. No railroad company shall run any train on any road operated by it within this state, between sunrise and sunset on Sunday, except from necessity or mercy; provided, that be-

fore ten o'clock and thirty minutes in the forenoon and after three o'clock in the afternoon it may run trains carrying the United States mail, and such other trains or classes of trains as may be authorized by the Railroad Commissioners of this state, on application made to them on the ground that the same are required by the public necessity, or for the preservation of freight.

ACTS OF 1899.

CHAPTER 48.

An Act concerning Powers of the Railroad Commissioners.

Be it enacted by the Senate and House of Representatives in General Assembly convened:

Sunday trains.

SECTION 1. The railroad commissioners are hereby empowered, on application made to them on the ground of public necessity, to authorize the running on any railroad of any train or trains carrying the United States mail or any other trains between ten o'clock and thirty minutes in the forenoon and three o'clock in the afternoon on Sunday.

Repeal.

SEC. 2. All acts and parts of acts inconsistent herewith are hereby repealed.

SEC. 3. This act shall take effect from its passage.

Approved, April 6, 1899.

Freight not to be handled on Sunday between certain hours.

SEC. 3524. No railroad company shall permit the handling, the loading, or the unloading of freight on any road operated by it, or at any of the depots or stations within this state, between sunrise and sunset on Sunday, except from necessity or mercy.

ACTS OF 1889.

CHAPTER XXIII.

An Act concerning Railroad Service on Sunday.

Be it enacted by the Senate and House of Representatives in General Assembly convened:

Handling of freight by railroad company on Sunday morning.

SECTION 1. Section 3524 of the general statutes is hereby amended by adding thereto the following: *provided, however,* that the railroad commissioners of this state may suspend the operation of this section, so as to permit the handling, the loading or the unloading of freight by transfer of said freight between steamboats and cars, until eight o'clock in the forenoon, at any depot or station where, upon application made to them, they shall find that the same is required by the public necessity or for the preservation of freight.

SEC. 2. This act shall take effect from its passage.

Approved, March 14, 1889.

Freight cars to be provided with safety couplers.

SEC. 3537. Every railroad company, operating any railroad located partially or wholly in this state, shall cause every freight car that shall be built or purchased for use on such railroad, to be provided with couplers so arranged as to render the presence of any person between the ends of the cars unnecessary for the purpose of coupling the same.

Such couplers to be approved by railroad commissioners.

SEC. 3538. No couplers shall be placed on any freight cars built or purchased as specified in the preceding section, nor shall any new couplers be substituted for any in use, until the same shall have been approved by the railroad commissioners, and such couplers shall be hung at such height above the face of the railroad track as shall be designated by such commissioners.

Penalty.

SEC. 3539. Every railroad company which shall permit a violation of the two preceding sections, shall forfeit to the State for every such violation the sum of fifty dollars.

Certain employes to wear badges.

SEC. 3549. All the conductors, brakemen, and baggagemen, employed upon the passenger trains of any railroad company, shall wear, when on duty, in a conspicuous place, a badge denoting their respective duties and the name of such company.

Number of brakemen on train.

SEC. 3566. Upon every train run, or intended to be run, upon any railroad in this state, at a greater average speed than thirty miles an hour, between stations, and consisting of more than two passenger cars, one brakeman shall be kept at the brake of each car; but when the double-action brake is used on any such train, but one brakeman need be kept upon and for every two cars connected with such train; and the railroad commissioners may grant permission to any railroad company to reduce the number of brakemen required upon passenger trains, when such company may have adopted a system of brakes to be operated by the engineer, which in the opinion of said commissioners may render such number of brakemen unnecessary; but said commissioners may revoke such permission when they consider the public safety requires; and on such revocation such company shall place upon its train the number of brakemen required by law.

CHAPTER CCXXV.

State Reform School.

Duties and powers of trustees.

SEC. 3624. The board of trustees shall manage the interests of said school according to law; adopt rules for its management and the maintenance of strict discipline therein; provide instruction in religion, morality, and useful knowledge, and in some regular course of labor for the inmates; bind them out, discharge, or remand them; appoint and remove at pleasure, a superintendent, not of their number, and other officers;

prescribe their duties and compensation; adjust and certify all claims and accounts against said school; and annually report under oath, to the governor, the condition and rules of the school.

Boy may be indentured as apprentice.

SEC. 3631. The trustees shall have full power to place any boy committed to said school during minority, at such employment, and cause him to be instructed in such branches of useful knowledge as may be suitable to his years and capacity; and they may, with the consent of any such boy, or his parents, or guardians, bind him out as an apprentice during his minority, or for a shorter period, to learn a trade, or to other employment, as in their judgment will tend to his future benefit; and the president of the board shall, for such purpose, have power to execute and deliver, on behalf of the said board, indentures of apprenticeship for any such boy; and such indentures shall have the same force and effect as indentures of apprenticeship executed by his legal guardian, and shall be filed with the records in the office of the reform school.

Trustees still to have control of person and earnings of such boy.

SEC. 3635. The trustees of said school shall have and exercise full control of the persons and earnings of boys so placed out during their minority, and shall, at least once during every period of six months, obtain by authorized visitation or inspection, definite and reliable information concerning their general deportment and progress in the occupations they are pursuing, and in general shall exercise in their behalf the care and supervision of guardians. The number and general condition of boys so placed out and cared for, shall be embraced in the annual report of the trustees of the school.

Inmates of reformatory schools may be bound out as apprentices.

SEC. 3677. The trustees of the state reform school may bind out as apprentices, and the directors of the Connecticut industrial school for girls may bind out to service, persons committed to such schools, respectively, for a term not exceeding the term of their commitment.

Parent or guardian may indenture child to reformatory school.

SEC. 3678. Any parent or guardian may indenture a child or ward to the state reform school, or to the Connecticut industrial school for girls, on such uniform terms as may be agreed upon between such parent or guardian and the trustees or directors of said schools, the expense to be paid quarterly, in advance; and in case of any failure on the part of such parent or guardian so to pay said expense, the superintendent of said state reform school, or Connecticut industrial school for girls, as the case may be, may sue on such agreement.

Privileges of child indentured to a reformatory school.

SEC. 3679. Every child indentured or admitted to the state reform school, or the Connecticut industrial school for girls, shall be entitled to the same supervision, medical treatment, support, and education, and subject to the same regulations, employment, and restraint, as all its other inmates.

CHAPTER CCXXXV.

Owner or parent, or master of owner, etc., when liable.

SEC. 3761. When any dog shall do any damage, either to the body or property of any person, the owner or keeper, or if the owner or keeper be a minor, his parent or guardian, or if he be an apprentice, his master, shall be liable for such damage.

ACTS OF 1889.

CHAPTER CXXIV.

An Act concerning Employment in the Public Service of the State of Connecticut.

Be it enacted by the Senate and House of Representatives in General Assembly convened:

Veterans given preference.

SECTION 1. In every public department, and upon all public works of this state, honorably discharged Union soldiers and sailors shall be preferred for appointment and employment. Age, loss of limb, or other physical impairment which does not in fact incapacitate, shall not be deemed to disqualify them, provided they possess the other requisite qualifications.

SEC. 2. This act shall take effect upon its passage.

Approved, May 7, 1889.

ACTS OF 1893.

CHAPTER LXXVII.

An Act concerning Seats for Female Operatives.

Be it enacted by the Senate and House of Representatives in General Assembly convened:

Seats to be provided for females employed in various establishments.

SECTION 1. Every person, partnership, or corporation employing females, in any mercantile, mechanical, or manufacturing establishment in this state, shall furnish and provide suitable seats for the use of all females so employed, and shall permit the use of such seats by said females when they are not necessarily engaged in the active duties for which they are employed.

Penalty.

SEC. 2. Any person, partnership, or corporation violating any of the provisions of this act shall be punished by a fine of not less than five dollars nor more than fifty dollars for each and every offense.

Approved, April 25, 1893.

ACTS OF 1893.

CHAPTER CLXII.

An Act concerning Labels and Trade-Marks of Trades Unions.

Be it enacted by the Senate and House of Representatives in General Assembly convened:

Imitation of label or trade-mark of trades union.

SECTION 1. Whenever any person, association, or union of workingmen have adopted, or shall hereafter adopt for their protection, any label, trade-mark, or form of advertisement announcing that goods to which such label, trade-mark, or form of advertisement shall be attached were manufactured by such person or by a member or members of such association or union, it shall be unlawful for any person or corporation to counterfeit or imitate such label, trade-mark, or form of advertisement. Every person violating this section shall upon conviction be punished by imprisonment in the county jail for not less than three months nor for more than one year, or by a fine of not less than one hundred dollars nor more than two hundred dollars, or both.

Penalty.

Use of such counterfeit or imitation.

SEC. 2. Every person who shall use any counterfeit or imitation of any label, trade-mark, or form of advertisement of any such person, union, or association, knowing the same to be counterfeit or imitation, shall be guilty of a misdemeanor, and shall be punished by imprisonment in the county jail for a term of not less than three months nor more than one year, or by a fine of not less than one hundred dollars nor more than two hundred dollars, or both.

Filing label or trade-mark with the secretary.

SEC. 3. Every such person, association, or union that has heretofore adopted, or shall hereafter adopt a label, trade-mark, or form of advertisement as aforesaid, may file the same for record in the office of the secretary of the state by leaving two copies, counterparts, or facsimiles thereof, with the secretary of the state; said secretary shall deliver to such person, association, or union so filing the same a duly attested certificate of the record of the same, for which he shall receive a fee of one dollar. Such certificate of record shall in all suits and prosecutions under this act be sufficient proof of the adoption of such label, trade-mark, or form of advertisement, and of the right of said person, association, or union to adopt the same. No label shall be recorded that would probably be mistaken for a label already of record.

Injunction against use of counterfeit label, etc.

SEC. 4. Every such person, association, or union adopting a label, trade-mark, or form of advertisement, as aforesaid, may proceed by suit to enjoin the manufacture, use, display, or sale of any such counterfeits or imitations, and all courts having jurisdiction thereof shall grant injunctions to restrain such manufacture, use, display, or sale; and shall award the com-

plainant in such suit, such damages, resulting from such wrongful manufacture, use, display, or sale, as may by said court be deemed just and reasonable, and shall require the defendants to pay to such person, association, or union the profits derived from such wrongful manufacture, use, display, or sale; and such court shall also order that all such counterfeits or imitations in the possession or under the control of any defendant in such case be delivered to an officer of the court or to the complainant, to be destroyed.

Unauthorized use of genuine label, etc.

SEC. 5. Every person who shall use or display the genuine label, trade-mark, or form of advertisement of any such person, association, or union, in any manner not authorized by such person, union, or association, knowing that such use or display is not so authorized, shall be deemed guilty of a misdemeanor, and shall be punished by imprisonment in the county jail not less than three months nor more than one year, or by a fine of not less than one hundred dollars nor more than two hundred dollars, or both. In all cases where such association or union is not incorporated, suits under this act may be commenced and prosecuted by any officer or member of such association or union in behalf of and for the use of such association or union.

Unauthorized use of name or seal of trades union.

SEC. 6. Any person or persons who shall in any way use the name or seal of any such person, association, or union, or officer thereof, in and about the sale of goods or otherwise, not being authorized to so use the same, knowing that such use is unauthorized, shall be guilty of a misdemeanor, punishable by imprisonment in the county jail for not less than three months nor more than one year, or by a fine of not less than one hundred dollars nor more than two hundred dollars, or both.

Approved, May 25, 1893.

ACTS OF 1895.

CHAPTER XLIX.

An Act amending an Act establishing a Fund for the Benefit of Disabled and Meritorious Policemen.

Be it enacted by the Senate and House of Representatives in General Assembly convened:

Former policemen to receive portion of fund for benefit of disabled and meritorious policemen, when.

SECTION 1. Section three of chapter cxvi of the public acts of 1893 is hereby amended by adding to said section the following: Said board of police commissioners or police committee may, at its discretion, by affirmative vote of the whole number of its members and with the approval of the mayor, direct a sum not exceeding five hundred dollars a year, payable in installments as said board shall direct, to be paid from said fund to any former member of the regular police force during

his life, who, after long and meritorious service as such police officer, and during said service, and without fault or misconduct on his part, shall have become permanently disabled by total blindness, so as to be entirely unfit to perform police duty, and who, because of such disability, shall have been, since May 18, 1888, and prior to the passage of this act, honorably discharged from police duty; *provided*, that such payments may at any time be stopped, or the amount of such payments be changed, by a vote of a majority of the whole number of said commissioners or committee, with the approval of the mayor.

SEC. 2. This act shall take effect from its passage.

Approved, April 3, 1895.

ACTS OF 1895.

CHAPTER CCXXXIX.

An Act creating a State Board of Mediation and Arbitration.

Be it enacted by the Senate and House of Representatives in General Assembly convened:

Appointment of State Board of Arbitration.

SECTION 1. During each biennial session of the general assembly the governor shall, with the advice and consent of the senate, appoint a state board of mediation and arbitration, to consist of three competent persons, each of whom shall hold his office for the term of two years. One of said persons shall be selected from the party which at the last general election cast the greatest number of votes for governor of this state, and one of said persons shall be selected from the party which at the last general election cast the next greatest number of votes for governor of this state, and the other of said persons shall be selected from a *bona fide* labor organization of this state. Said board shall select one of its number to act as clerk or secretary, whose duty it shall be to keep a full and faithful record of the proceedings of the board, and also to keep and preserve all documents and testimony submitted to said board; he shall have power, under the direction of the board, to issue subpoenas, and to administer oaths in all cases before said board, and to call for and examine books, papers, and documents of the parties to such cases. Said arbitrators shall take and subscribe to the constitutional oath of office before entering upon the discharge of their duties.

Appointment and duties of clerk and secretary.

Matters that may be submitted to the State Board of Arbitration.

SEC. 2. Whenever any grievance or dispute of any nature shall arise between any employer and his employes, it shall be lawful for the parties to submit the same directly to the state board of mediation and arbitration, in case such parties elect to do so, and shall notify said board, or its clerk, in writing, of such election. Whenever such notification to said board or its clerk is given, it shall be the duty of said board to proceed, with

as little delay as possible, to the locality of such grievance or dispute, and inquire into the cause or causes of the grievance or dispute. The parties to the grievance or dispute shall thereupon submit to said board, in writing, succinctly, clearly, and in detail, their grievances and complaints, and the cause or causes thereof, and severally promise and agree to continue in business, or at work, without a strike or lockout until the decision of said board is rendered; *provided*, it shall be rendered within ten days after the completion of the investigation. The board shall thereupon proceed fully to investigate and inquire into the matters in controversy, and to take testimony under oath in relation thereto, and shall have power by its chairman or clerk to administer oaths, to issue subpoenas for the attendance of witnesses, and the production of books and papers.

Duties of the board.

Decision to be in writing and in triplicate.

SEC. 3. After a matter has been fully heard, the said board, or a majority of its members, shall within ten days render a decision thereon in writing, signed by the members of the board, or a majority of them, stating such details as will clearly show the nature of the decision and the points disposed of by said board. The decision shall be in triplicate, one copy of which shall be filed by the clerk of the board in the office of the town clerk or city clerk in the town or city where the controversy arose, and one copy shall be served on each of the parties to the controversy.

Duty of the board in case of strike or lockout.

SEC. 4. Whenever a strike or lockout shall occur, or is seriously threatened in any part of the state, and shall come to the knowledge of the board, it shall be its duty, and it is hereby directed to proceed, as soon as practicable, to the locality of such strike or lockout and put itself in communication with the parties to the controversy, and endeavor by mediation to effect an amicable settlement of such strike or lockout; and if, in the judgment of said board, it is best, it shall inquire into the cause or causes of the controversy, and to that end the board is hereby authorized to subpoena witnesses and send for persons and papers.

Report.

SEC. 5. Said board shall, on or before the first day of December in each year, make a report to the governor, and shall include therein such statements, facts, and explanations as will disclose the actual working of the board, and such suggestions as to legislation as may seem to it conducive to harmony in the relations between employers and employed, and to the improvement of the present system of production.

SEC. 6. Whenever the term "employer" or "employers" is used in this act, it shall be held to include "firm," "joint stock association," "company" or "corporation" as fully as if each of the last-named terms was expressed in each place.

SEC. 7. The members of the board shall receive, as compen-

sation for actual services rendered under this act, the sum of five dollars per day and expenses, upon presentation of their voucher to the comptroller, approved by the governor.

SEC. 8. This act shall take effect from its passage.

Approved, June 28, 1895.

ACTS OF 1895.

CHAPTER CCXCV.

An Act concerning Italian and other Alien Laborers.

Be it enacted by the Senate and House of Representatives in General Assembly convened:

Alien laborers to be informed of their rights.

SECTION 1. The commissioner of the bureau of labor statistics is hereby authorized to appoint some competent person or persons, familiar with the language of Italian, Polish, or other alien laborers, as special agents of the bureau, whose duty it shall be to inform said laborers, either personally or through printed matter in their language, as to their right of contract under the law of the state, and to prevent, as far as possible, any illegal advantage being taken of said laborers by reason of their ignorance, credulity, or want of knowledge of the English language.

Appointment of special agents, temporarily.

SEC. 2. The appointment of said special agents shall not be permanent, but simply to meet the exigencies of each case as presented to the commissioner, and they shall be paid a similar per diem compensation to that paid to other agents of the bureau, the total per diem expense in any one year not to exceed three hundred dollars.

Penalty for retaining wages.

SEC. 3. Any person who shall obtain or receive money due Italian, Polish, or other foreign laborers, ignorant of the English language, and shall retain any part thereof for his own use without giving adequate consideration therefor, shall, upon conviction, be punished by a fine of not more than one hundred dollars, or imprisonment for one year, or both.

Approved, July 4, 1895.

ACTS OF 1897.

CHAPTER CLXXXIV.

An Act concerning Blacklisting.

Blacklisting forbidden.

Every employer who shall blacklist an employe with intent to prevent such employe from procuring other employment shall, upon conviction, be fined not more than two hundred dollars.

Approved, May 25, 1897.

ACTS OF 1897.

CHAPTER CCXLI.

An Act providing for Enclosed Vestibules and Gates upon Street Railway Cars.

Railroad Commissioners may direct that platforms of cars be enclosed.

SECTION 1. Whenever the railroad commissioners deem it needful in the interests of the public or employes thereon concerned, that the platforms of any or all of the cars operated upon any street railway in this state should be protected by gates or vestibules more or less enclosed, said commissioners may order the company operating such car or cars to enclose the platforms thereon with gates or vestibules, or both, of the kind and in such manner as they may deem necessary and proper for the protection of said interests, first giving such company reasonable notice to appear and be heard thereon, and may from time to time similarly modify or revoke any such order; and said commissioners shall have sole and exclusive jurisdiction with respect to requiring that the platforms of any street railway car or cars be protected or enclosed by gates or vestibules.

Penalty.

SEC. 2. Any company operating such car or cars which shall neglect or refuse to comply with any such order shall forfeit to the treasurer of the state twenty-five dollars for each day of such neglect or refusal.

SEC. 3. All acts or parts of acts inconsistent herewith are hereby repealed.

SEC. 4. This act shall take effect upon its passage.

Approved, June 11, 1897.

ACTS OF 1899.

CHAPTER 170.

An Act concerning the Coercion of Employes.

Be it enacted by the Senate and House of Representatives in General Assembly convened:

Employer not to bind employee to refrain from joining labor organizations.

SECTION 1. No person or persons, firm or corporation, either directly or by an agent, shall coerce or compel, or attempt to coerce or compel, any laborer, mechanic, or other employe in the employ of such person or persons, firm or corporation, to enter into an agreement, either verbal or written, that, as a condition of retaining his position as such employe, he will not join any labor organization.

Penalty.

SEC. 2. Every person or the agent of any firm or corporation who shall violate the provisions of this act shall be fined not more than two hundred dollars, or imprisoned not more than six months.

SEC. 3. This act shall take effect from its passage.

Approved, June 9, 1899.

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State of Connecticut.

NINTH REPORT

OF THE

DAIRY COMMISSIONER,

MADE TO THE

GOVERNOR, A. D. 1899.

FOR THE

YEAR ENDING SEPTEMBER 30, 1899.

ORDERED PRINTED BY THE LEGISLATURE.

MERIDEN, CONN.:
RECORD-REPUBLICAN BOOK DEPARTMENT.
1899.

State of Connecticut,

DAIRY COMMISSIONER'S OFFICE,

ROOM 54, CAPITOL, HARTFORD.

TELEPHONE CALL, 1303.

JOHN B. NOBLE,
Commissioner.

ROBERT O. EATON,
Deputy Commissioner.

MISS B. WINONA PAGE,
Clerk and Stenographer.

REPORT.

To His Excellency George E. Lounsbury, Governor of the State of Connecticut:

SIR:—In compliance with the provisions of Chapter CCXCIV. of the Public Acts of 1895, I herewith have the honor to present to you my report for the fiscal year ending September 30, 1899.

The duties of the Dairy Commissioner are to attend to the enforcement of the law regulating the manufacture and sale of imitation butter, the law regulating the manufacture and sale of molasses and vinegar.

In 1897 the law concerning the selling of tub butter was passed at that session of the Legislature and was put under the control of this department. At the last session of the Legislature the duties of the office were much more extended. First, by the law regulating the sale of concentrated commercial feeding stuffs; and Second, in giving to the Dairy Commissioner power to examine all food products within the State, together with the enforcement of all pure food laws. The law concerning the manufacture and sale of imitation butter was first passed in 1886, and was entitled "An Act to Prevent and Punish Fraud." This law was amended in 1893, in 1895, and in 1897. These amendments have been fully explained in previous reports. The complete law as it now stands is here given:

LAW RELATING TO THE MANUFACTURE AND SALE OF IMITATION BUTTER.

SECTION 2614. Any article resembling butter in appearance and not made wholly, salt and coloring excepted, from the milk of cows, shall be imitation butter within the meaning of this chapter. The words "butter," "dairy," or "creamery" shall form neither the whole nor a part of the name of any imitation butter, nor appear upon any article, or upon any box, tub, or package containing imitation butter.

SEC. 2615. No person, by himself or his agents or servants, shall render or manufacture, sell, offer for sale, expose for sale, take orders for the future delivery of, or have in his possession with intent to sell, any article, product, or compound made wholly or partly out of any fat, oil, or oleaginous substance or compound thereof, not produced from unadulterated milk or cream from the same, which shall be in imitation of yellow butter produced from pure unadulterated milk or cream of the same; *provided*, that nothing in this act shall be construed to prohibit the manufacture or sale of oleomargarine in a separate and distinct form and in such manner as will advise the consumer of its real character, free from coloration or any ingredient that causes it to look like butter. No imitation butter shall be sold or exposed for sale or delivered, except under the following conditions: First, the seller shall maintain in plain sight, over or next the main outer entrance of the premises where the selling is done, a sign bearing in plain, black Roman letters, not less than two inches wide and four inches long, on a white ground, the words "sold here," preceded by the name of the imitation article. If the selling is done from a wagon or other vehicle, such vehicle shall conspicuously bear upon its outside, on both sides of such wagon or vehicle, such a sign. If the delivering is done from a wagon or other vehicle, such vehicle shall conspicuously bear upon its outside on both sides of said wagon or vehicle a sign bearing in plain, black, Roman letters, not less than two inches wide and four inches long, on a white ground, the words "delivered here," preceded by the name of the imitation article. Second, all imitation butter shall be kept in an enclosing package, which shall bear on the outside of its body, and also of its cover, at all times in plain sight of a beholder of the package, in black Roman letters, not less than one inch wide and two inches long, on a white or light-colored ground, the name of the imitation article. Third, the seller shall orally inform each buyer at each sale that the article he buys is not butter, and shall give the buyer the name of the imitation article. Fourth, every person, co-partnership, or corporation selling or offering for sale any imitation butter, and every keeper of a hotel, boarding-house, or restaurant, temporary or permanent, who shall furnish any guest with any imitation butter, or food containing it, shall within fifteen days after the passage of this act, or within fifteen days after commencing said business, and annually on the first day of May, or within fifteen days thereafter, register in a book kept by the Dairy Commissioner for that purpose the name and the town, street and number of street, of the place of business of said person, co-partnership, corporation, keeper of a hotel, boarding-house, or restaurant. All signs prescribed in sections 2615, 2616, and 2617 of the general statutes shall be provided by the Dairy Commissioner, and all signs required under provisions of section 2615 of the general statutes, to be maintained in plain sight over or next the main outer entrance of the premises where the selling is done, shall be placed in position under the direc-

tion of the Dairy Commissioner or his deputy. All signs so furnished by the Dairy Commissioner shall be paid for by the parties receiving the same, the same to be furnished at the actual cost thereof.

SEC. 2616. No baker or vender of food shall sell or expose for sale any article of food containing imitation butter unless such baker or vender shall maintain the same kind of a sign as hereinbefore first prescribed, in the way and manner prescribed in that connection, except that the word "used" shall be substituted for the word "sold." If the selling be done from a wagon, or other vehicle, such vehicle shall conspicuously bear such a sign.

SEC. 2617. No keeper of a hotel, boarding-house, or restaurant, temporary or permanent, shall furnish any guest with any imitation butter, or food containing it, unless such keeper shall maintain in plain sight of all guests sitting at tables where food is served such a sign or signs as hereinbefore prescribed, except that the word "used" shall be substituted for the word "sold."

SEC. 2618. The Governor shall appoint a citizen of the State as a Dairy Commissioner, who shall hold office for two years from and after the first day of May succeeding his appointment, and until his successor is appointed, unless sooner removed by the Governor for cause; and in case of his death, resignation, or removal, the Governor shall fill the vacancy. It shall be the duty of the Dairy Commissioner to attend to the enforcement of this chapter throughout the State. A room in the Capitol shall be set apart for the Dairy Commissioner. He may appoint and remove a deputy, who may also act as clerk. The Dairy Commissioner and his deputy shall have free access, at all reasonable hours, for the purpose of examining into any suspected violation of this chapter, to all places and premises, apartments of private families, keeping no boarder excepted, where the Dairy Commissioner or his deputy suspects imitation butter to be made, sold, used, kept, or stored in transit, and on tender of the market price of good butter for the same may take from any person, firm, or corporation samples of any articles suspected to be imitation butter. And it shall be the duty of agents of railroad and express companies having knowledge or record of any consignment of imitation butter to inform the Commissioner or his deputy of such consignment, and the name of the consignee, when requested by said Commissioner or his deputy. The Dairy Commissioner may have samples suspected to be imitation butter analyzed at the Connecticut Experiment Station, or by any State Chemist, and a sworn or affirmed certificate after analysis shall be *prima facie* evidence of the ingredients and constituents of the samples analyzed. Any one refusing the Dairy Commissioner or his deputy access in a reasonable manner, and at a reasonable time, to premises for said purpose of examination, or refusing to sell samples as hereinbefore provided for, shall incur the penalty hereinafter first provided for violations of this chapter. The Dairy Commissioner shall make an annual report to the Governor, and such

annual report shall be submitted to the general assembly at its regular session.

SEC. 2619. Any person violating any of the provisions of sections 2614, 2615, or 2616, and any person, except a boarding-house keeper, violating section 2617 shall for the first offense be fined not more than one hundred dollars or imprisoned not more than sixty days, or both ; for any subsequent offense said fine and imprisonment shall be doubled. Any boarding-house keeper violating section 2617 shall for the first offense be fined twenty-five dollars or imprisoned not exceeding thirty days, or both ; for any subsequent offense said fine and imprisonment last mentioned shall be doubled. Evidence of any violation of this chapter shall be *prima facie* evidence of willful violation with knowledge.

Approved, May 18, 1893, March 28, 1895.

OLEOMARGARINE.

The law regulating the manufacture and sale of imitation butter is in many respects one of the most important over which this department has control. The interest of everyone who is engaged in the manufacture and sale of butter is affected by it, as well as every consumer. As stated in former reports, when the first law was passed in 1886 there were large quantities of oleomargarine sold in the State, and it seemed at that time as though the dairy interests of the State would be strongly affected by it, but through the enforcement of strongly and carefully prepared laws this has all been changed. At the present time there is very little oleomargarine sold in the State, although at different times we find it in nearly every part of the State. Last winter it was found that quite a quantity came to New London depot at different times. Careful investigation was made, and it was found that an agent of one of the Providence companies was taking orders for and delivering oleomargarine to quite a number of parties in town. Prosecution was at once brought against the agent, who was convicted and fined. Others have attempted to do the same in other places, but in consequence of the very effective amendments to the law which was passed in 1895, through the efforts of Commissioner Burlingame, it has been stopped. We have six licensed dealers in the State, they are all registered and displaying the proper signs in their stores, and they are selling oleomargarine according to the law, but the temptation is very strong to sell it yellow in delivery wagons and in stores when the Dairy Commissioner is not expected. We

visited a licensed store in Waterbury last summer just as a woman bought, as she supposed, a pound of butter, for which she paid twenty-five cents. Being suspicious of the tub, we asked for a pound. The clerk refused, but the proprietor coming in, sold us a pound, but it was stamped as oleomargarine. The parties were prosecuted, and a fine of $100 was paid.

As was stated in my last report, there is some oleomargarine sold in Waterbury. It is shipped to order of some fictitious persons, and whoever has the order for the goods of course gets them. At one time we found thirty-two tubs of sixty pounds each at the depot, with no address except Waterbury. Watch was kept for several days, when an order came to ship the goods back to Providence.

We have made systematic investigation in the different cities of the State of the stores, delivery wagons, peddlers' wagons, boarding-houses, and hotels, in order to locate if possible all the places where oleomargarine is sold or used contrary to law, the amendment which was passed by the Legislature of 1897, giving the Commissioner or his deputy power to examine depots and express offices, together with the right to obtain information from the railroad and express companies as to the transportation of oleomargarine, has been a great help to us in ascertaining when it is brought into a town.

The methods of taking samples was fully explained in my last report. With the firm price of butter such as there has been this season, and the probability is that it will increase during the winter, it is quite sure that there will be strong efforts made to sell yellow oleomargarine in the place of pure butter, and constant watchfulness will be necessary to keep it in check.

Since the date of this report another prosecution and conviction has been made in Waterbury for selling oleomargarine. The following figures are taken from the last report of the Commissioner of Internal Revenue, showing the amount of oleomargarine manufactured in the country, and the increase in the last two years :

1897, amount manufactured.....	45,531,207	pounds.
1898, " "	57,516,136	"
1899, " "	80,495,628	"

The United States law defining and regulating the manufacture and sale, the importation and exportation of oleomargarine is here given :

[Treasury Department, Document No. 1385, Internal Revenue.]

OLEOMARGARINE LAWS.

(24 Stat., 209.)

AN ACT defining butter, also imposing a tax upon and regulating the manufacture, sale, importation, and exportation of oleomargarine.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled :

SECTION 1. That for the purposes of this act the word "butter" shall be understood to mean the food product usually known as butter, and which is made exclusively from milk or cream, or both, with or without common salt, and with of without additional coloring matter.

SEC. 2. That for the purposes of this act certain manufactured substances, certain extracts, and certain mixtures and compounds, including such mixtures and compounds with butter, shall be known and designated as "oleomargarine," namely : All substances heretofore known as oleomargarine, oleo, oleomargarine-oil, butterine, lardine, suine, and neutral ; and all mixtures and compounds of oleomargarine, oleo, oleomargarine-oil, butterine, lardine, suine, and neutral ; all lard extracts and tallow extracts ; and all mixtures and compounds of tallow, beef-fat, suet, lard, lard-oil, vegetable-oil, annotto, and other coloring matter, intestinal fat, and offal fat made in imitation or semblance of butter, or when so made, calculated or intended to be sold as butter or for butter.

SEC. 3. That special taxes are imposed as follows :

Manufacturers of oleomargarine shall pay six hundred dollars. Every person who manufactures oleomargarine for sale shall be deemed a manufacturer of oleomargarine.

Wholesale dealers in oleomargarine shall pay four hundred and eighty dollars. Every person who sells or offers for sale oleomargarine in the original manufacturers' packages shall be deemed a wholesale dealer in oleomargarine. But any manufacturer of oleomargarine who has given the required bond and paid the required special tax, and who sells only oleomargarine of his own production, at the place of manufacture, in the original packages to which the tax-paid stamps are affixed, shall not be required to pay the special tax of a wholesale dealer in oleomargarine on account of such sales.

Retail dealers in oleomargarine shall pay forty-eight dollars. Every person who sells oleomargarine in less quantities than ten pounds at one time shall be regarded as a retail dealer in oleomarga-

rine. And sections 3232, 3233, 3234, 3235, 3236 3237, 3238, 3239, 3240, 3241, 3243 of the Revised Statutes of the United States are, so far as applicable, made to extend to and include and apply to the special taxes imposed by this section, and to the persons upon whom they are imposed: * *Provided*, That in case any manufacturer of oleomargarine commences business subsequent to the thirtieth day of June in any year, the special tax shall be reckoned from the first day of July in that year, and shall be five hundred dollars.

SEC. 4. That every person who carries on the business of a manufacturer of oleomargarine without having paid the special tax therefor, as required by law, shall, besides being liable to the payment of the tax, be fined not less than one thousand and not more than five thousand dollars; and every person who carries on the business of a wholesale dealer in oleomargarine without having paid the special tax therefor, as required by law, shall, besides being liable to the payment of the tax, be fined not less than five hundred nor more than two thousand dollars; and every person who carries on the business of a retail dealer in oleomargarine without having paid the special tax therefor, as required by law, shall, besides being liable to the payment of the tax, be fined not less than fifty nor more than five hundred dollars for each and every offense.

SEC. 5. That every manufacturer of oleomargarine shall file with the Collector of Internal Revenue of the district in which his manufactory is located such notices, inventories, and bonds, shall keep such books and render such returns of material and products, shall put up such signs and affix such number to his factory and conduct his business under such surveillance of officers and agents as the Commissioner of Internal Revenue, with the approval of the Secretary of the Treasury, may, by regulation, require. But the bond required of such manufacturer shall be with sureties satisfactory to the Collector of Internal Revenue, and in a penal sum of not less than five thousand dollars; and the sum of said bond may be increased from time to time, and additional sureties required at the discretion of the Collector, or under instructions of the Commissioner of Internal Revenue.

SEC. 6. That all oleomargarine shall be packed by the manufacturer thereof in firkins, tubs, or other wooden packages not before used for that purpose, each containing not less than 10 pounds, and marked, stamped, and branded as the Commissioner of Internal Revenue, with the approval of the Secretary of the Treasury, shall prescribe; and all sales made by manufacturers of oleomargarine, and wholesale dealers in oleomargarine, shall be in original stamped packages. Retail dealers in oleomargarine must sell only from original stamped packages, in quantities not exceeding ten pounds, and shall pack the oleomargarine sold by them in suitable wooden

* Repealed; see section 53, act of October 1, 1890.

or paper packages, which shall be marked and branded as the Commissioner of Internal Revenue, with the approval of the Secretary of the Treasury, shall prescribe. Every person who knowingly sells or offers for sale, or delivers or offers to deliver, any oleomargarine in any other form than in new wooden or paper packages as above described, or who packs in any package any oleomargarine in any manner contrary to law, or who falsly brands any package or affixes a stamp on any package denoting a less amount of tax than that required by law, shall be fined for each offense not more than one thousand dollars, and be imprisoned not more than two years.

SEC. 7. That every manufacturer of oleomargarine shall securely affix, by pasting, on each package containing oleomargarine manufactured by him, a label on which shall be printed, besides the number of the manufactory and the district and State in which it is situated, these words: "Notice — The manufacturer of the oleomargarine herein contained has complied with all the requirements of law. Every person is cautioned not to use either this package again or the stamp thereon again, nor to remove the contents of this package without destroying said stamp, under the penalty provided by law in such cases." Every manufacturer of oleomargarine who neglects to affix such label to any package containing oleomargarine made by him, or sold or offered for sale by or for him, and every person who removes any such label so affixed from any such package, shall be fined fifty dollars for each package in respect to which such offense is committed.

SEC. 8. That upon oleomargarine which shall be manufactured and sold, or removed for consumption or use, there shall be assessed and collected a tax of two cents per pound, to be paid by the manufacturer thereof; and any fractional part of a pound in a package shall be taxed as a pound. The tax levied by this section shall be represented by coupon stamps; and the provisions of existing laws governing the engraving, issue, sale, accountability, effacement, and destruction of stamps relating to tobacco and snuff, as far as applicable, are hereby made to apply to stamps provided for by this section.

SEC. 9. That whenever any manufacturer of oleomargarine sells, or removes for sale or consumption, any oleomargarine upon which the tax is required to be paid by stamps, without the use of the proper stamps, it shall be the duty of the Commissioner of Internal Revenue, within a period of not more than two years after such sale or removal, upon satisfactory proof, to estimate the amount of tax which has been omitted to be paid, and to make an assessment therefor and certify the same to the Collector. The tax so assessed shall be in addition to the penalties imposed by law for such sale or removal.

SEC. 10. That all oleomargarine imported from foreign countries shall, in addition to any import duty imposed on the same, pay an internal revenue tax of fifteen cents per pound, such tax to be repre-

sented by coupon stamps as in the case of oleomargarine manufactured in the United States. The stamps shall be affixed and canceled by the owner or importer of the oleomargarine while it is in the custody of the proper custom-house officers; and the oleomargarine shall not pass out of the custody of said officers until the stamps have been so affixed and canceled, but shall be put up in wooden packages, each containing not less than ten pounds, as prescribed in this act for oleomargarine manufactured in the United States, before the stamps are affixed; and the owner or importer of such oleomargarine shall be liable to all the penal provisions of this act prescribed for manufactures of oleomargarine manufactured in the United States. Whenever it is necessary to take any oleomargarine so imported to any place other than the public stores of the United States for the purpose of affixing and cancelling such stamps, the Collector of Customs of the port where such oleomargarine is entered shall designate a bonded warehouse to which it shall be taken under the control of such customs officer as such Collector may direct; and every officer of customs who permits any such oleomargarine to pass out of his custody or control without compliance by the owner or importer thereof with the provisions of this section relating thereto, shall be guilty of a misdemeanor, and shall be fined not less than one thousand dollars nor more than five thousand dollars, and imprisoned not less than six months nor more than three years. Every person who sells or offers for sale any imported oleomargarine, or oleomargarine purporting or claimed to have been imported, not put up in packages and stamped as provided by this act, shall be fined not less than five hundred dollars nor more than five thousand dollars, and be imprisoned not less than six months nor more than two years.

SEC. 11. That every person who knowingly purchases or receives for sale any oleomargarine which has not been branded or stamped according to law shall be liable to a penalty of fifty dollars for each such offense.

SEC. 12. That every person who knowingly purchases or receives for sale any oleomargarine from any manufacturer who has not paid the special tax shall be liable for each offense to a penalty of one hundred dollars, and to a forfiture of all articles so purchased or received, or of the full value thereof.

SEC. 13. That whenever any stamped package containing oleomargarine is emptied, it shall be the duty of the person in whose hands the same is to destroy utterly the stamps thereon; and any person who willfully neglects or refuses so to do shall for each such offense be fined not exceeding fifty dollars, and be imprisoned not less than ten days nor more than six months. And any person who fraudulently gives away or accepts from another, or who sells, buys, or uses for packing oleomargarine, any such stamped package, shall for each such offense be fined not exceeding one hundred dollars, and

be imprisoned not more than one year. Any revenue officer may destroy any emptied oleomargarine package upon which the tax-paid stamp is found.

SEC. 14. That there shall be in the office of the Commissioner of Internal Revenue an analytical chemist and a microscopist, who shall each be appointed by the Secretary of the Treasury, and shall each receive a salary of two thousand five hundred dollars per annum; and the Commissioner of Internal Revenue may, whenever in his judgment the necessities of the service so require, employ chemists and microscopists, to be paid such compensation as he may deem proper, not exceeding in the aggregate any appropriation made for that purpose. And such Commissioner is authorized to decide what substances, extracts, mixtures, or compounds which may be submitted for his inspection in contested cases are to be taxed under this act; and his decision in matters of taxation under this act shall be final. The Commissioner may also decide whether any substance made in imitation or semblance of butter, and intended for human consumption, contains ingredients deleterious to the public health; but in case of doubt or contest his decisions in this class of cases may be appealed from to a board hereby constituted for the purpose, and composed of the Surgeon-General of the Army, the Surgeon-General of the Navy, and the Secretary of Agriculture; and the decisions of this board shall be final in the premises.

SEC. 15. That all packages of oleomargarine subject to tax under this act that shall be found without stamps or marks as herein provided, and all oleomargarine intended for human consumption which contains ingredients adjudged, as hereinbefore provided, to be deleterious to the public health, shall be forfeited to the United States. Any person who shall willfully remove or deface the stamps, marks, or brands on package containing oleomargarine taxed as provided herein shall be guilty of a misdemeanor, and shall be punished by a fine of not less than one hundred dollars nor more than two thousand dollars, and by imprisonment for not less than thirty days nor more than six months.

SEC. 16. That oleomargarine may be removed from the place of manufacture for export to a foreign country without payment of tax or affixing stamps thereto, under such regulations and the filing of such bonds and other security as the Commissioner of Internal Revenue, with the approval of the Secretary of the Treasury, may prescribe. Every person who shall export oleomargarine shall brand upon every tub, firkin, or other package containing such article the word "oleomargarine," in plain Roman letters not less than one-half inch square.

SEC 17. That whenever any person engaged in carrying on the business of manufacturing oleomargarine defrauds, or attempts to defraud, the United States of the tax on the oleomargarine produced by him, or any part thereof, he shall forfeit the factory and manu-

facturing apparatus used by him, and all oleomargarine and all raw material for the production of oleomargarine found in the factory and on the factory premises, and shall be fined not less than five hundred dollars nor more than five thousand dollars, and be imprisoned not less than six months nor more than three years.

SEC. 18. That if any manufacturer of oleomargarine, any dealer therein, or any importer or exporter thereof, shall knowingly or willfully omit, neglect, or refuse to do, or cause to be done, any of the things required by law in the carrying on or conducting of his business, or shall do anything by this act prohibited, if there be no specific penalty or punishment imposed by any other section of this act for the neglecting, omitting, or refusing to do, or for the doing or causing to be done, the thing required or prohibited, he shall pay a penalty of one thousand dollars; and if the person so offending be the manufacturer of or a wholesale dealer in oleomargarine, all the oleomargarine owned by him, or in which he has any interest as owner, shall be forfeited to the United States.

SEC. 19. That all fines, penalties, and forfeitures imposed by this act may be recovered in any court of competent jurisdiction.

SEC. 20. That the Commissioner of Internal Revenue, with the approval of the Secretary of the Treasury, may make all needful regulations for the carrying into effect of this act.

SEC. 21. That this act shall go into effect on the ninetieth day after its passage; and all wooden packages containing ten or more pounds of oleomargarine found on the premises of any dealer on or after the ninetieth day succeeding the date of the passage of this act shall be deemed to be taxable under section eight of this act, and shall be taxed, and shall have affixed thereto the stamps, marks, and brands required by this act or by regulations made pursuant to this act; and for the purposes of securing the affixing of the stamps, marks, and brands required by this act, the oleomargarine shall be regarded as having been manufactured and sold, or removed from the manufactory for consumption or use, on or after the day this act takes effect; and such stock on hand at the time of the taking effect, of this act may be stamped, marked, and branded under special regulations of the Commissioner of Internal Revenue, approved by the Secretary of the Treasury; and the Commissioner of Internal Revenue may authorize the holder of such packages to mark and brand the same and to affix thereto the proper tax-paid stamps.

Approved, August 2, 1886.

AN ACT to reduce the revenue and equalize duties on imports, and for other purposes.

. . . . . .

SEC. 41. That wholesale dealers in oleomargarine shall keep such books and render such returns in relation thereto as the Commissioner of Internal Revenue, with the approval of the Secretary of the Treasury, may, by regulation, require, and such books shall be

open at all times to the inspection of any internal revenue officer or agent.

. . . . . .

SEC. 53. That all special taxes shall become due on the first day of July, eighteen hundred and ninety one, and on the first day of July in each year thereafter, or on commencing any trade or business on which such tax is imposed. In the former case the tax shall be reckoned for one year ; and in the latter case it shall be reckoned proportionately, from the first day of the month in which the liability to a special tax commenced to the first day of July following. Special tax stamps may be issued for the months of May and June, eighteen hundred and ninety (*one*), upon payment of the amount of tax reckoned proportionately under the laws now in force, and such stamps which have been or may be issued for the period ending April thirtieth, eighteen hundred and ninety (*one*), may, upon payment of one-sixth of the amount required to be paid for such stamps for one year, be extended until July first, eighteen hundred and ninety-one, under such regulations as may be prescribed by the Commissioner of Internal Revenue. And it shall be the duty of special tax-payers to render their returns to the deputy collector at such times within the calendar month in which the special tax liability commenced as shall enable him to receive such returns, duly signed and verified, not later than the last day of the month, except in cases of sickness or absence, as provided for in section 3176 of the Revised Statutes.

. . . . . .

SEC. 55. That all laws and parts of laws inconsistent with this act are hereby repealed, *Provided, however*, That the repeal of existing laws, or modifications thereof, embraced in this act shall not affect any act done or any right accruing or accrued, or any suit or proceeding had or commenced in any civil cause before the said repeal or modifications, but all rights and liabilities under said laws shall continue and may be enforced in the same manner as if said repeal or modification had not been made.

Any offenses committed, and all penalties, or forfeitures, or liabilities incurred under any statute embraced in, or changed, modified, or repealed by this act may be prosecuted and punished, in the same manner and with the same effect as if this act had not been passed. All acts of limitation, whether applicable to civil causes and proceedings or to the prosecution of offenses, or for the recovery of penalties or forfeitures, embraced in, or modified, changed, or repealed by this act, shall not be affected thereby, and all suits, proceedings, or prosecutions, whether civil or criminal, for causes arising or acts done or committed prior to the passage of this act may be commenced and prosecuted within the same time and with the same effect as if the act had not been passed.

Approved, October 1, 1890.

[Series 7, No. 9—Revised, March 12, 1891.]

REGULATIONS.

UNDER

AN ACT entitled "An act defining butter, also imposing a tax upon and regulating the manufacture, sale, importation, and exportation of oleomargarine," approved August 2, 1886, and "An Act to reduce the revenue and equalize duties on imports, and for other purposes," approved October 1, 1890.

TREASURY DEPARTMENT,
OFFICE OF INTERNAL REVENUE,
WASHINGTON, March 12, 1891.

Section 20 of the act of August 2, 1886, above referred to, provides:

"That the Commissioner of Internal Revenue, with the approval of the Secretary of the Treasury may make all needful regulations for the carrying into effect of this act."

In pursuance thereof the following regulations have been made by the Commissioner of Internal Revenue, with approval of the Secretary of the Treasury, and are hereby promulgated:

Oleomargarine Defined.

Butter is defined in section 1 of the act, and oleomargarine, which is the special subject of these regulations, in section 2 thereof, as follows:

"That for the purposes of this act the word 'butter' shall be understood to mean the food product usually known as butter, and which is made exclusively from milk or cream, or both, with or without common salt, and with or without additional coloring matter.

"SEC 2. That for the purposes of this act certain manufactured substances, certain extracts, and certain mixtures and compounds, including such mixtures and compounds, with butter, shall be known and designated as 'oleomargarine' namely: All substances heretofore known as oleomargarine, oleo, oleomargarine-oil, butterine, lardine, suine and neutral; all mixtures and compounds of oleomargarine, oleo, oleomargarine-oil, butterine, lardine, suine, and neutral; all lard extracts and tallow extracts; and all mixtures and compounds of tallow, beef-fat, suet, lard, lard-oil, vegetable-oil, annotto, and

other coloring matter, intestinal fat and offal fat made in imitation or semblance of butter, or when so made, calculated or intended to be sold as butter or for butter."

The Attorney-General of the United States has rendered an opinion, under date of October 18, 1886, to the effect that the last clause of section 2 of the act of August 2, 1886, should be construed as qualifying all the preceding portion of said section. He says: "In my opinion, the qualification extends to the whole section, and is an essential element of the statutory definition of oleomargarine."

In deference to the above opinion, said section is construed as though it read as follows:

"That for the purposes of this act certain manufactured substances, certain extracts, and certain mixtures and compounds, including such mixtures, and compounds with butter, shall be known and designated as 'oleomargarine' whenever made in imitation or semblance of butter, or, when so made, calculated or intended to be sold as butter or for butter, namely: All substances heretofore known as oleomargarine, oleo, oleomargarine-oil, butterine, lardine, suine, and neutral; all mixtures and compounds of oleomargarine, oleo, oleomargarine-oil, butterine, lardine, suine, and neutral; all lard extracts and tallow extracts, and all mixtures and compounds of tallow, beef-fat, suet, lard, lard-oil, vegetable-oil, annotto, and other coloring matter, intestinal fat, and offal fat."

The mixture of butter with coloring matter does not, under this law, render it liable to tax as oleomargarine, such mixture being permitted under the definition given in the first section. If, however, the annotto or other coloring matter is mixed with a vegetable-oil or an animal fat other than butter fat as a mordant resulting in a compound resembling butter, this compound would be liable to tax as oleomargarine when manufactured and sold or removed.

It has been urged that the quantity so added would be minute, and that a portion at least would also be lost in the buttermilk, etc. A number of samples known to have been colored with a butter color, in which oil was used as a mordant, have been examined in this office without resulting in the discovery of any foreign fat or oil.

Under the circumstances, collectors are advised before levying the oleomargarine tax upon butter so colored to submit a sample for the inspection of this office, provided the coloring

matter in the suspected butter is the only ground for the belief that it is oleomargarine

To ascertain what substances were known before the passage of this act as oleomargarine, oleo, oleomargarine-oil, butterine, lardine, suine, and neutral, reference may be had to dictionaries and standard works defining and describing these substances. In Webster's dictionary oleomargarine is defined to be artificial butter made from animal fat, with the addition of some milk and other substances; and butterine is therein defined to be a substitute for butter, made from animal fat, called also oleomargarine.

A very full description of the manufacture of oleomargarine from beef-fat is given in "Appleton's Annual Cyclopædia" for 1882.

Descriptions of oleomargarine, oleo, oleomargarine-oil, butterine, and neutral were given to the Committee on Agriculture and Forestry of the United States Senate shortly before the passage of the act. Some of these descriptions are given on pages 11 and 12 of these regulations. Hereafter, from time to time, as occasion may arise in the practical enforcement of the law, collectors will be instructed as to the views of this office in regard to substances taxable as oleomargarine.

It appears from the testimony of Prof. Henry Morton, of the Stevens Institute of Technology, Hoboken, N. J., that all animal fats, including butter, are mainly composed of three kinds of fatty substances, vix.: a substance, (stearine) which is solid at ordinary temperatures, a substance (palmatin) which has the usual consistency of butter at ordinary temperatures, and a third substance (olein) which is liquid at ordinary temperatures. It also appears that the invention which has rendered the business of manufacturing the oleomargarine of commerce possible is that process by which all the animal fibre and nearly all the excess of stearine is removed from the beef-fat, so that the proportion of stearine, palmatin, and olein is nearly the same as in butter.

It further appears in evidence before the above-named committee that the oleomargarine-oil is principally obtained from the caul fat of beeves very soon after the animals are killed, and that the manufacturing plant needed to produce the article economically would cost not less than $5,000 or $6,000, or with the slaughter-house attached, not less than 10,000. Establishments of such magnitude are easily discovered and are likely to

be found adjoining or near slaughter-houses and in connection with pork-packing establishments. Lard is used to considerable extent, especially in winter. The oleomargarine made from beef fat being too brittle in winter, owing principally to the excess of stearine not being all removed, lard is added to overcome this defect.

The following definitions of oleo-oil, oleomargarine, butterine, and neutral are from statements made to the Senate Committee on Agriculture and Forestry, June 16, 1886, by a member of a firm most extensively engaged in the manufacture of these substances :

"The method of producing oleo-oil is as follows: The selected fat is taken from the cattle in the process of slaughtering, and after thorough washing is placed in a bath of clean cold water and surrounded with ice, where it is allowed to remain until all animal heat has been removed. It is then cut into small pieces by machinery, and melted at an average temperature of 150 degrees until the fat in liquid form has separated from the fibrine or tissue, and then settled until it is perfectly clear. Then it is drawn into graining-vats and allowed to stand a day, when it is ready for the process. The pressing extracts the stearine, leaving the remaining product, known as oleo-oil. It is this article which, when churned with cream or milk, or both, and with sometimes a small proportion of creamery butter, the whole being properly salted, gives the new food product oleomargarine. Each animal yields and average of about forty pounds of oleo oil.

. . . . . .

"The difference between oleomargarine and butterine is this: In making butterine we use neutral lard, which is made from selected leaf-lard prepared and rendered in a very similar manner to oleo-oil, excepting that no stearine is extracted, This neutral lard, which is a beautifully white and odorless product, is cured in salt brine for forty-eight to seventy hours at an ice-water temperature. It is then taken, and with the desired proportions of oleo-oil and the finest creamery butter, is churned with cream and milk, producing an article which, when properly salted and packed, is ready for market. We use the same coloring that is used by all butter makers, and which has already been fully described. The butterine is generally made of two qualities, differing only in the proportions of the ingredients used. In cold weather a little salad oil, made from selected cotton-seed, is used in both products for the improvement of their texture. We get an average of about eight pounds of raw leaf-lard per hog, which render net about five to six pounds of neutral. This

neutral is worth from two to three cents per pound over ordinary steam-rendered lard.

. . . . . .

"Oleomargarine is mainly made of oleo-oil exclusively, but sometimes 5 per cent of the finest butter is added, which is churned with the cream and milk to improve the flavor.

"Creamery butterine is usually composed of 25 per cent. creamery butter, 40 per cent. neutral, 20 per cent. oleo-oil, and the balance milk, cream and salt.

"Dairy butterine differs from creamery only in the proportions. It is a cheaper product, and its proportion of butter about 10 per cent., neutral 45 per cent., and oleo-oil 25 per cent., the balance being made up of cream, milk, and salt."

He also testifies as follows as to lard, etc. :

"The fat from the hog is a very small percentage. This leaf-lard is the choicest fat from the hog, and only weighs about eight pounds in the rough. We get about five pounds of neutral from a hog, when we ordinarily get about forty pounds of lard.

. . . . . .

"We use only the selected parts from each animal, the caul-fat from the steer, and the leaf-lard from the hog."

WHOLESALE DEALERS.

Special Taxes.

Section 3 of the act of August 2, 1886, provides as follows :

"Wholesale dealers in oleomargarine shall pay four hundred and eighty dollars. Every person who sells or offers for sale oleomargarine in the original manufacturers' packages shall be deemed a wholesale dealer in oleomargarine. But any manufacturer of oleomargarine who has given the required bond and paid the required special tax, and who sells only oleomargarine of his own production at the place of manufacture, in the original packages to which the tax-paid stamps are affixed, shall not be required to pay the special tax of a wholesale dealer in oleomargarine on account of such sales. . . . And sections 3,232, 3,233, 3,234, 3,235, 3,236, 3,237, 3,238, 3,239, 3,240, 3,241, and 3,243 of the Revised Statutes of the United States are, so far as applicable, made to extend to and include and apply to the special taxes imposed by this section, and to the persons upon whom they are imposed."

Section 53 of the act of October 1, 1890, provides as follows :

"That all special taxes shall become due on the first day of July,

one thousand eight hundred and ninety-one, and on the first day of July in each year thereafter, or on commencing any trade or business on which such tax is imposed. In the former case the tax shall be reckoned for one year; and in the latter case it shall be reckoned proportionately from the first day of the month in which the liability to a special tax commenced to the first day of July following. Special tax stamps may be issued for the months of May and June, one thousand eight hundred and ninety-one, upon payment of the amount of tax reckoned proportionately under the laws now in force, and such stamps which have been or may be issued for the period ending April thirtieth, one thousand eight hundred and ninety (*one*), may, upon payment of one-sixth of the amount required to be paid for such stamps for one year, be extended until July first, one thousand eight hundred and ninety-one, under such regulations as may be prescribed by the Commissioner of Internal Revenue. And it shall be the duty of special taxpayers to render their returns to the deputy collector at such times within the calendar month in which the special tax liability commenced as shall enable him to receive such returns, duly signed and verified, not later than the last day of the month, except in cases of sickness or absence, as provided for in section 3,176 of the Revised Statutes."

Section 4 of the act of August 2, 1886, imposes fines upon those who do business rendering them liable to special tax as wholesale dealers in oleomargarine under the law without paying the special tax, as follows:

. . . "And every person who carries on the business of a wholesale dealer in oleomargarine without having paid the special tax therefor, as required by law, shall, besides being liable to the payment of the tax, be fined not less than five hundred nor more than two thousand dollars."

Under the above provisions of law every person intending to engage in the business of wholesale dealing in oleomargarine must register with the Collector of Internal Revenue for the district in which the business is to be carried on, his name or style, place of residence, and the place where the business is to be carried on, and purchase his special tax-stamp.

In case of a firm or company, the names of the several persons constituting the same, and their places of residence, must be so registered. All persons who are in the business June 30 must take similar action before continuing business from July 1.

A person, even if he is a retail dealer in oleomargarine, may solicit orders for oleomargarine in wholesale quantities, and send these orders to the wholesale dealer or to the manufacturer, and

receive therefor an allowance as brokerage, without subjecting himself to a special tax as a wholesale dealer, provided the wholesale dealers (or the manufacturers, if the orders are sent to them) ship the original stamped packages to the persons ordering direct and unconditionally, without any intervention on the part of the broker in the delivery. The receipt of commission or brokerage, under these circumstances, for the orders obtained is immaterial so far as the special tax question is concerned. (32 Record, p. 373.)

A manufacturer of oleomargarine, after having discontinued business, directed one wholesale dealer in oleomargarine who held some of his goods to consign the same to another wholesale dealer in oleomargarine, who sold the same on the late manufacturer's account on commission.

It is held that these transactions do not make the late manufacturer a wholesale dealer, as the special-tax stamp of the wholesale dealer who sold the goods covered the sale at his place of business of the packages belonging to the late manufacturer, which the dealer received as such manufacturer's property, and sold on commission for him and on his account as his agent.

Wholesale Dealers' Packages.

Under the provisions of section 3, above quoted, and of the following clause in section 6 of the same act, "all sales made by manufacturers of oleomargarine and wholesale dealers in oleomargarine shall be in original stamped packages," wholesale dealers cannot sell or offer for sale oleomargarine in any form but the manufacturer's original unbroken package.

A wholesale dealer should assure himself that every package which he purchases or receives for sale bears the proper internal revenue brands and stamps in view of the provisions of section 11 of the act of August 2, 1886, which reads as follows:

"That every person who knowingly purchases or receives for sale any oleomargarine which has not been branded or stamped according to law shall be liable to a penalty of fifty dollars for each such offense."

A wholesale dealer is required to account for each package of oleomargarine, by the serial number thereon, received into his establishment, as hereinafter prescribed.

It is clearly the intent of the law relative to oleomargarine

that purchasers of that commodity shall be informed, at the time of purchase, of the true nature of the article, by marks, brands, and stamps to be placed thereon; hence manufacturers and dealers are not permitted to send out or ship packages of oleomargarine concealed in boxes, barrels, jute bags, burlap, or other article of covering. Packages may be sent out or shipped in crates or other similar devices, provided they are so packed in such crates or devices that the internal revenue marks, brands, stamps, etc., are plainly exposed to public view.

Any package of oleomargarine found upon the market so packed as to conceal any of the marks, brands, stamps, etc., from plain view to the public, will be liable to detention or seizure. (37 Record, p. 21.)

Books and Returns of Wholesale Dealers in Oleomargarine.

Section 41 of the act of October 1, 1890, provides:

"That wholesale dealers in oleomargarine shall keep such books and render such returns in relation thereto as the Commissioner of Internal Revenue, with the approval of the Secretary of the Treasury, may, by regulation, require, and such books shall be open at all times to the inspection of any internal revenue officer or agent."

Under the above provision of law wholesale dealers will be required to keep books and render returns as follows:

Book to be Kept by Wholesale Dealers.

1. Every wholesale dealer in oleomargarine is required to enter in a book, Form 61, the number of packages and pounds of oleomargarine received, the number of packages and pounds, also the serial numbers of packages disposed of, and the name and place of business or residence of each person to whom sold or consigned.

2. This book must always be kept at the dealer's place of business, and be always open to the inspection of any internal revenue officer or agent.

Returns of Wholesale Dealers in Oleomargarine.

Wholesale dealers in oleomargarine will make monthly returns on Form 217 (with inside sheets when needed to complete the detailed statements) showing in detail the serial numbers of packages and number of pounds of oleomargarine received direct from manufacturers and other wholesale dealers, also the quan-

tity disposed of, with the name and address of each person to whom sold or consigned. These returns will be rendered on the first day of the month succeeding that for which the return is made, or within five days thereafter, in duplicate, to the collector, who will forward one copy to the Commissioner of Internal Revenue.

RETAIL DEALERS.

Special Taxes.

Section 3 of the act of August 2, 1886, provides as follows:

"Retail dealers in oleomargarine shall pay forty-eight dollars. Every person who sells oleomargarine in less quantities than ten pounds at one time shall be regarded as a retail dealer in oleomargarine. And sections 3,232, 3,233, 3,234, 3,235, 3,236, 3,237, 3,238, 3,239, 3,240, 3,241, and 3,243 of the Revised Statutes of the United States are, so far as applicable, made to extend to and include and apply to the special taxes imposed by this section, and to the persons upon whom they are imposed."

. . . . . .

Section 53 of the act of October 1, 1890, provides:

"That all special taxes shall become due on the first day of July, eighteen hundred and ninety-one, and on the first day of July in each year thereafter, or on commencing any trade or business on which such tax is imposed. In the former case the tax shall be reckoned for one year; and in the latter case it shall be reckoned proportionately, from the first day of the month in which the liability to a special tax commenced to the first day of July following. Special tax stamps may be issued for the months of May and June, eighteen hundred and ninety-one, upon payment of the amount of tax reckoned proportionately under the laws now in force, and such stamps which have been or may be issued for the period ending April thirtieth, eighteen hundred and ninety (*one*), may, upon payment of one-sixth of the amount required to be paid for such stamps for one year, be extended until July first, eighteen hundred and ninety-one, under such regulations as may be prescribed by the Commissioner of Internal Revenue. And it shall be the duty of special taxpayers to render their returns to the Deputy Collector at such times within the calendar month in which the special tax liability commenced as shall enable him to receive such returns, duly signed and verified, not later than the last day of the month, except in cases of sickness or absence, as provided for in section 3,176 of the Revised Statutes."

Section 4 of the act of August 2, 1886, imposes fines upon those who do business rendering them liable to special tax as re-

tail dealers in oleomargarine under the law without paying the special tax, as follows :

. . . . . .

"and every person who carries on the business of a retail dealer in oleomargarine without having paid the special tax therefor, as required by law, shall, besides being liable to the payment of the tax, be fined not less than fifty nor more than five hundred dollars for each and every offense."

Under the above provisions of law every person intending to engage in the business of retail dealing in oleomargarine must register with the Collector of Internal Revenue for the district in which the business is to be carried on, his name or style, place of residence, and the place where the business is to be conducted, and purchase his special tax stamp. In case of a firm or company, the names of the several persons constituting the same, and their places of residence, must be so registered. All persons who are in the business June 30, must take similar action before continuing the business from July 1.

Retail Dealers' Packages.

The form in which retail dealers may sell oleomargarine is prescribed in section 6 of the act of August 2, 1886, which reads as follows :

"That all oleomargarine shall be packed by the manufacturer thereof, in firkins, tubs, or other wooden packages not before used for that purpose, each containing not less than ten pounds, and marked, stamped and branded as the Commissioner of Internal Revenue, with the approval of the Secretary of the Treasury, shall prescribe ; and all sales made by manufacturers of oleomargarine, and wholesale dealers in oleomargarine shall be in original stamped packages. Retail dealers in oleomargarine must sell only from original stamped packages, in quantities not exceeding ten pounds, and shall pack the oleomargarine sold by them in suitable wooden or paper packages, which shall be marked and branded as the Commissioner of Internal Revenue, with the approval of the Secretary of the Treasury, shall prescribe. Every person who knowingly sells or offers for sale, or delivers or offers to deliver, any oleomargarine in any other form than in new wooden or paper packages as above described, or who packs in any package any oleomargarine in any manner contrary to law, or who falsely brands any package or affixes a stamp on any package denoting a less amount of tax than that required by law, shall be fined for each offense not more than one thousand dollars, and be imprisoned not more than two years."

A retail dealer in oleomargarine is permitted by the section above quoted to sell as much as ten pounds of oleomargarine at one sale; but as the same section requires him to sell it from the original stamped package, and section 3 of the act precludes his selling the original stamped package without payment of special tax by him as a wholesale dealer, the only course for him to pursue under these circumstances is to sell this quantity directly from the original stamped package, and deliver it in another package, properly marked and branded, to the purchaser.

See decisions reported under section 3, published in volume 32, Record, p. 318.

While a retail dealer who sells from "original stamped packages" to one person at one time quantities of oleomargarine aggregating more than ten pounds, which he puts up and delivers in other packages, each containing ten pounds or less, does not thereby involve himself in special-tax liability as a wholesale dealer, since a wholesale dealer in oleomargarine is defined by the statute to be "every person who sells or offers for sale oleomargarine in the original manufacturers' packages;" yet he incurs the penalty of $1,000 imposed by section 18 of the act of August 2, 1886, by his infringement of the provisions of section 6 of the act, in selling more than ten pounds at one time, unless he can show that the oleomargarine in each package so delivered differed in grade from that in the other packages delivered on the same order, and was, therefore, the subject of a separate sale, upon the the principal laid down by the court in United States *vs.* Wm. V. James (30 Record, p. 29; 32 Record, p. 381).

As the retail dealer is required to sell *from* original stamped packages, and cannot, as a retail dealer, sell *in* such packages, he is compelled to make up his own packages.

Retail dealers must not take oleomargarine from the original stamped packages and put it up in other packages *in advance of sales*, and sell such packages. They thereby involve themselves in liability to fine of $1,000, under section 18 of the act of August 2, 1886. Their oleomargarine must remain in the original stamped packages until bargained for and ordered by the customer. (34 Record, p. 17.)

New wooden or paper packages similar to those usually employed in selling butter and lard at retail may be used by the retail dealer in oleomargarine. It is required that each package shall be strong enough to hold the oleomargarine securely, with the

exercise of ordinary diligence on the part of the purchaser, until it is delivered at the point of destination.

Each retailer's wooden or paper package must have the name and address of the dealer *printed* or *branded* thereon, likewise the words "pound" and "oleomargarine," in letters not less than one-quarter of an inch square, and the quantity *written*, *printed*, or *branded* thereon in figures of the same size (one-quarter of an inch square) substantially as follows :

a _____

b _____

c _____

½ POUND OLEOMARGARINE.

The words "Oleomargarine" and "Pound," which are required to be printed or branded on retailers' wooden or paper packages, in letters not less than one-quarter of an inch square, and the quantity, which is required to be *written, printed or branded* thereon in figures of like size, must be so placed as to be plainly visible to the purchaser at the time of delivery to him. Illegible or concealed marks and brands are not those contemplated and required by the law and regulations. It will not be deemed a compliance with this regulation if the word "Oleomargarine" and the other required words and figures shall be illegibly branded or printed, or so placed as to be concealed from view, by being on the inside of the package, or by folding in the stamped portion of the paper sheet used for wrapping, or otherwise. The required words and figures must be legibly printed or branded and conspicuously placed, and no other word or business card should be placed in such juxtaposition thereto as to divert attention from the fact that the contents of the package are wholly oleomargarine.

Black ink must be used on white or light-colored paper or wood. The color of the ink with which the words are printed must be in the strongest contrast to the color of the package.

The question having arisen as to whether retail dealers in oleomargarine may continue the practice of wrapping their goods

a Here give dealer's name. *b* Here give street number.
c Here give name of city, or town.

delivered to customers in ordinary brown wrapping paper, such packages being similar to those usually employed in selling butter and lard at retail, and being also marked as required by the regulations, it is held that such practice is deemed in compliance with the law.

The purchaser, in these cases, is notified of the nature of the article purchased, which seems to be the leading purpose of the provision.

The penalty imposed upon retail dealers for knowingly selling or offering to sell oleomargarine in any other form than in new wooden or paper packages is prescribed in section 6, above quoted.

Section 13 of the act of August 2, 1886, provides that whenever any stamped package containing oleomargarine is emptied, it shall be the duty of the person in whose hands the same is, to destroy utterly the stamps thereon, and upon such person as willfully neglects or refuses so to do, imposes a fine for each offense of not less than fifty dollars, and imprisonment not less than ten days, nor more than six months.

The same section also imposes a fine for each offense not exceeding one hundred dollars, and imprisonment not more than one year upon any person who fraudulently gives away or accepts from another, or who sells, buys, or uses for packing oleomargarine, any empty stamped package.

Any revenue officer may destroy any emptied oleomargarine package upon which the tax-paid stamp is found.

Sections 11 and 12 impose penalties as follows upon any person who knowingly purchases or receives for sale packages that have not been branded and stamped, and for knowingly purchasing or receiving oleomargarine for sale from any manufacturer who has not paid the special tax as such :

SEC. 11. That every person who knowingly purchases or receives for sale any oleomargarine which has not been branded or stamped according to law shall be liable to a penalty of fifty dollars for each such offense.

SEC. 12. That every person who knowingly purchases or receives for sale any oleomargarine from any manufacturer who has not paid the special tax shall be liable for each offense to a penalty of one hundred dollars, and to a forfeiture of all articles so purchased or received, or of the full value thereof.

It is the duty of dealers in butter to ascertain the true character of the article which they sell or offer for sale ; and if they are found to have sold oleomargarine, though they allege that they believed it to be genuine butter, the special tax and fifty per centum additional will be assessed against them.

DAIRY STATISTICS.

Number of cows in the United States in 1899 15,990,115

Number of cows in Connecticut.....	1850	85,461
" " "	1860	98,877
" " "	1870	98,889
" " "	1880	116,319
" " "	1890	127,892
" " "	1899	143,098

Increase the last year, 4,168.

Average yearly milk product per cow in Connecticut :

1860.	277.2	gallons.
1870.....	290.9	"
1880.....	325.4	"
1890.....	425.4	"

Total milk product in Connecticut, 1899.....60,413,822 gallons.

Butter made in Connecticut.....	1850	6,498,119
" " " "	1860	7,620,912
" " " "	1870	6,716,007
" " " "	1880	8,414,906
" " " "	1890	10,369,259

NUMBER AND VALUE OF MILCH COWS.

The following table shows the number, average price, and total value of milch cows in each state:

STATE.	Number.	Average Price	Value.
Maine	197,828	$30.50	$ 6,035,279
New Hampshire	136,825	33.65	4,604,161
Vermont	271,602	30.85	8,378,922
Massachusetts	179,791	37.75	6,787,110
Rhode Island	25,510	39.90	1,017,889
Connecticut	143,098	35.55	5,087 134
New York	1,458,251	33.55	48,924,321
New Jersey	214,674	38.15	8,189,813
Pennsylvania	924,260	31.50	29,114,190
Delaware	35,376	28.95	1,024,135
Maryland	155,022	26.95	4,177,843
Virginia	244,937	22.25	5,499,848
North Carolina	248,243	15.93	1,782,316
South Carolina	126,762	16.75	2,123,264
Georgia	297,324	23.00	6,838,452
Florida	114,251	15.60	1,782,316
Alabama	252,727	15.45	3,935,532
Mississippi	256,951	18.90	4,856,374
Louisiana	125,747	19.10	2,401,765
Texas	700.802	23.75	16,644,048
Arkansas	196,808	19.40	3,818,075
Tennessee	254,675	22.05	5,615,584
West Virginia	163,895	27.50	6,301,483
Kentucky	248,808	25.40	6,304,483
Ohio	736,735	31.05	22,875,622
Michigan	459,107	31.30	14,370,049
Indiana	611,975	31.10	19,032,422
Illinois	1,001,212	33.60	33,640,723
Wisconsin	895,822	31.30	28,039,229
Minnesota	646,673	29.45	19,044,520
Iowa	1,250,975	34.40	43,026,660
Missouri	673,196	27.80	18,714,821
Kansas	684,475	31.05	21,128,190
Nebraska	628,750	33.40	21,000,250
South Dakota	372,321	29.20	10,871,773
North Dakota	171,073	28.00	4,892,688
Montana	43,994	34.30	1,513,394
Wyoming	18,140	38.10	691,134
Colorado	91,666	34.95	3,203,727
New Mexico	19,317	31.00	598,827
Arizona	18,404	29.60	544,758
Utah	57,787	27.60	1,594,621
Nevada	18,069	29.25	528,518
Idaho	31,500	28.20	888,300
Washington	115,485	30.20	3,487,647
Oregon	116,581	25.85	3,013,619
California	318,425	38.00	8,915,900
Oklahoma	37,114	28.40	1,051,198

LEGAL STANDARDS FOR DAIRY PRODUCTS, 1898.

The following table shows the requirements for articles sold under the names specified. States having no laws are not mentioned.

States.	Milk			Cream.	Butter
	Total Solids, Per Cent.	Solids not Fat, Per Cent.	Fat	Fat, Per Cent.	Fat, Per Cent.
District of Columbia,	..	9	3.5	.20	.83
Georgia,	12	..	3.	..	..
Illinois,	12.5	..	3.	..	..
Iowa,	12	..	3.	.15	..
Maine,	12	..	3.	..	..
Massachusetts,	13	9.3	3 7	..	..
Massachusetts, April to August,	12	..	3.	..	..
Michigan,	12.5	..	3.	..	..
	Specific Gravity 1029.33.				
Minnesota,	13	..	3.5	.20	..
New Hampshire,	13	..	..	..	..
New Jersey,	12	..	..	..	..
New York,	12	..	3.	..	..
Ohio,	12	..	3.	..	.80
" May and June,	11.5	..	..	..	..
Oregon,	12	..	3.	..	..
Pennsylvania,	12.5	..	3.	..	..
Rhode Island,	12	..	2.5	..	..
South Carolina,	..	8.5	3.	..	..
Vermont,	12.5	9.2	..	..	..
Washington,	..	8.	3.	..	..
Wisconsin,	..	..	3.	..	..

CONNECTICUT DAIRYMEN'S ASSOCIATION.

The Connecticut Dairyman's Association was incorporated by an act of the Legislature in 1889. It was organized several years before. This organization has been a great benefit to the dairy interests of the State. Its object being to improve the

dairy and all connected with it. The officers of the Association for 1899 are :

President—J. B. Noble, East Windsor.
Vice-President—H. F. Potter, Montowese.
Secretary—G. E. Manchester, West Winsted.
Treasurer—W. I. Bartholomew, Putnam.

DIRECTORS.

C. H. Sage, West Norfolk.
H. F. Miner, Vernon.
R. B. Eno, Weatogue,
J. G. Schwink, Jr., Meriden.
Richard Davis, Middletown.
W. O. Seymour, Ridgefield.
C. B. Pomeroy, Jr., Willimantic.
I. W. Stark, Lebanon.

The annual meeting of this Association is held the third week in January. Prominent dairymen from all parts of the State are members of the Association and take an active part in all of its work. Dairy Institutes are held at various times upon invitation in different towns. Men prominent in dairy work from different parts of the country are among the speakers at the institutes and the annual meetings. There is also a large exhibit of dairy products from the different creameries and private dairies held in connection with the winter meeting. There is always a large attendance and great interest is manifested by all concerned in dairying.

CONNECTICUT CREAMERY ASSOCIATION.

The following is the Constitution of the Connecticut Creamery Association, with the officers for the present year :

President—E. R. Russell, Suffield.
Vice-President—Hiram Carter, Plainville.
Sec. and Treas.—Frank Avery, Wapping.

DIRECTORS.

B. F. Case, Canton.
E. D. Hammond, Cromwell.
H. P. Deming, Robertsville.
E. B. Little, Somers.
C. P. Reynolds, Jewett City.
D. E. Phelps, Windsor.
Francis Deming, Berlin.
John Brown, Merrow.

CONSTITUTION.

This Association shall be known as THE CONNECTICUT CREAMERY ASSOCIATION.

ARTICLE I.

Membership.

Any creamery organization or individual engaged in the manufacture of butter may become a member of this Association upon the payment of two ($2.00) dollars and subscribing to the Constitution and By-Laws.

ARTICLE II.

The officers of this Association shall consist of a President, Vice-President, Secretary and Treasurer, and eight Directors, to be elected by ballot. The President, Vice-President, and Secretary and Treasurer to be also members of the Board of Directors.

ARTICLE III.

The annual meeting of this Association shall be held on the second Wednesday of January, 1893, at which meeting the election of the officers shall be held. Notices of all meetings of this Association shall be mailed to each member.

BY-LAWS.

ARTICLE I.

SECTION. 1. The regular meeting of the Board of Directors shall be held quarterly ; on the second Wednesday of January and on the third Wednesday of April, July and October.

SEC. 2. Not less than five (5) members of the Board of Directors shall constitute a quorum at any regular meeting for the transaction of business, and a majority of those present shall decide all questions, nclu ding applications for membership.

ARTICLE II.

It shall be the duty of the Secretary to keep the minutes of the proceedings of each meeting of the Association and of the Board of Directors ; he shall issue all notices of meetings, receive and refer to the Directors all applications for membership ; he shall qualify himself to give any imformation upon topics and matters connected with the manufacture and sale of butter ; he shall have the custody of the books, records, and other property of the Association, and for his services shall receive such compensation as may be voted by the Directors ; he shall also receive all fees and dues for membership, hold the custody of all moneys, and shall keep a correct account of all funds of the Association, and shall only pay out said moneys upon bills bearing the approval of the President.

ARTICLE III.

There shall be an Auditing Committee of two members of the Association, who shall be appointed by the President, who shall audit the accounts of the Secretary and Treasury, and report to the Association at their annual meeting.

ARTICLE IV.

A special meeting may be called by the Secretary whenever in the judgment of the President and Secretary it may seem necessary, giving each director five days' notice.

MANAGEMENT OF THE CREAMERIES OF THE STATE.

The managers of the creameries of the State have courteously given me statistics in regard to their work during the last year, which enables me to present the following tabulary statement in regard to their business for the year. The map given will show the locations of these creameries.

	Name.	Situation.	Co-operative or Proprietary.	Amount of Capital.
1	Andover,	Andover,	Co-operative,	$4,000
2	Aspetuck,	Northville,	Co-operative,	1,500
3	Avon,	Avon,	Co-operative,	4,000
4	Brooklyn,	Brooklyn,	Co-operative.	
5	Canton,	Canton Center,	Co-operative,	3,675
6	Chapinville,	Chapinville,	Proprietary.	
7	Cheshire,	Cheshire,	Proprietary,	2,000
8	Clover Farms,	Redding.		
9	Colchester,	Colchester,	Co-operative,	3,750
10	Cromwell,	Cromwell,	Co-operative,	3,500
11	Danbury,	Danbury,	Proprietary,	3,000
12	Durham,	East Wallingford,	Co-operative,	2,000
13	East Canaan,	East Canaan,	Co-operative,	3,500
14	Eastford,	Eastford,	Co-operative,	2,975
15	East Granby,	East Granby,	Co-operative,	3,000
16	East Haddam,	Goodspeeds,	Co-operative,	3,950
18	Echo Farm,	Litchfield,	Proprietary,	100,000
19	Ellington,	Ellington,	Co-operative,	4,850
20	Elmwood,	Elmwood,	Private.	
21	Farmington,	Farmington,	Co-operative,	3,975
22	Glastonbury,	Glastonbury,	Proprietary,	3,700
23	Golden Ridge,	Berlin,	Co-operative,	3,000
24	Goshen,	West Goshen,	Co-operative,	3,000
25	Granby,	Granby,	Co-operative,	3,550
26	Green's Farms,	Westport,	Co-operative.	
27	Highland,	West Hartford,	Co-operative,	3,800

	Name.	Situation.	Co-operative or Proprietary.	Amount of Capital.
28	Jewett City,	Griswold,	Co-operative,	$3,600
29	Lebanon,	Lebanon,	Co-operative,	3,400
30	Mansfield,	Merrow,	Co-operative,	3,600
31	Mountain Spring,	Durham,	Proprietary.	
32	Northford,	Northford,	Proprietary,	2,800
33	Oak Shade,	Cheshire,	Proprietary,	2,000
34	Old Lyme,	Black Hall,	Proprietary,	3,000
35	Plainville,	Plainville.		
36	Ridgefield,	Ridgefield.		
37	Riverside,	Warehouse Point,	Co-operative,	4,000
38	Riverside,	Higganum,	Private.	
39	Scotland,	Scotland,	Co-operative,	1,800
40	Simsbury,	West Simsbury,	Co-operative,	2,500
41	Somers,	Somers,	Co-operative,	4,500
42	South Britain,	South Britain,	Proprietary,	5,000
43	Spring Brook,	South Wethersfield,	Co-operative,	3,000
44	Suffield,	Suffield,	Co-operative,	5,500
45	Taugwánk,	No. Stonington,	Co-operative,	3,000
46	Thompson,	Thompson,	Proprietary,	3,000
47	Torrington,	Torrington,	Proprietary,	900
48	Tunxis,	Robertsville	Co-operative,	3,000
49	Turnerville,	Turnerville,	Private.	
50	Valley Farm,	New Haven,	Proprietary,	20,000
51	Vernon,	Rockville,	Co-operative,	3,675
52	Wallingford,	Wallingford,	Co-operative,	4,400
53	Wapping,	South Windsor,	Co-operative,	3,500
54	Windsor,	Windsor,	Co-operative,	7,000
55	Winsted,	Winsted,	Proprietary,	2 000
56	Woodstock,	Woodstock,	Co-operative,	3,000
57	Neds Brook,	Canton,	Co-operative,	1,000

PRESENT BOARD OF OFFICERS AND SUPERINTENDENTS.

1 President and Treasurer, E. P. Skinner; Secretary, M. P. Yeomans; Superintendent, A. H. Lyman.

2 President, S. C. Camp; Secretary, V. B. Hatch; Superintendent, V. B. Hatch; Butter Maker, George W. Hill and J. Devereau.

3 President, C. R. Woodford; Secretary, Superintendent and Butter Maker, H. M. Lyman.

4

5 President, E. N. White; Secretary, Treasurer and Manager, B. F. Case.

6 Proprietors, Robert and Herbert Scoville; Manager, L. P. Ashman.

7 President, E. A. Atwater; Secretary and Treasurer, Edgar Beadle; Superintendent, Edward Shinners.

8

9 President, J. E. Hall; Secretary, S. E. Williams; Superintendent, William P. Adams; Butter Maker, D. C. Gillette.
10 President, Henry Gilbert; Secretary and Superintendent, E. D. Hammond; Butter Maker, E. T. Griggs.
11 Superintendent and Butter Maker, L. H. Boughton.
12 President, W. I. Parmelee; First Vice-President, W. L. Davis; Second Vice-President and Superintendent, J. D. Bartholomew.
13 President, C. H. Sage; Secretary, Treasurer and Manager, E. S. Roberts.
14 President, S. O. Bowen; Secretary and Treasurer, C. M. Jones.
15
16 President, S. B. Warner; Treasurer and Superintendent, L. M. Stark.
18 President, John S. Palmer; Secretary and Treasurer, A. B. Webster.
19 President and Superintendent, John Thompson; Secretary, J. T. McKnight; Butter Maker, John M. Allen.
20
21 President, C. Deming; Secretary and Treasurer, A. B. Wadsworth.
22 President, E. H. Andrews; Secretary, H. E. Loomis; Butter Maker, H. L. Lothrop.
23 President, W. H. Webster; Secretary and Superintendent, F. Deming; Butter Maker, L. H. Mallery.
24 Secretary and Treasurer, W. H. Wadhams; Superintendent, H. H. Ives.
25 President, George O. Beach; Superintendent and Treasurer, H. J. Dewey; Secretary, S. F. Holcombe.
26
27 President, Franklin Sisson; Secretary and Superintendent, Timothy Sedgewick; Butter Maker, A. J. Hunt.
28 President, E. A. Geer; Secretary, Superintendent and Butter Maker, B. W. Smith.
29 President, A. G. Kneeland; Secretary and Superintendent, N. Manning; Butter Maker, E. Pulz.
30 President, J. R. Hall; Superintendent, John Brown.
31 President, H. Page; Butter Maker, H. Page.
32 President, George W. Cook; Secretary, D. M. Foot; Treasurer, T. A. Smith.
33
34 Superintendent, D. E. Turner; Proprietor, Nathan Griswold.
35 President, A. Corbin; Secretary, Treasurer and Superintendent, Hiram Carter.
36
37 President, Charles T. Abbe; Secretary Horace Patten; Superintendent, C. T. Abbee; Butter Maker, H. B. Conger.
38
39 President, R. T. Haskins; Secretary, William G. Anthony; Superintendent and Butter Maker, E. B. Inman.

40 President, A. L. Latimer; Secretary and Superintendent, S. T. Stockwell; Butter Maker, Walter B. Smith.
41 President, M. P. Avery; Secretary and Superintendent, E. B. Little; Butter Maker, W. H. Daniels.
42 Proprietor, Hollister Sage.
43 President, S. W. Robbins; Vice-President, S. N. Wells; Secretary and Treasurer, George W. Harris.
44 President, Arthur Sykes; Secretary, G. F. Kendall; Superintendent, E. A. Russell; Butter Maker, E. C. Stratton.
45 President, Charles Maine; Secretary, W. H. Hillard; Superintendent, B. P. Wheeler; Butter Maker, D. E. Johnson.
46 Proprietor, L. A. Logee.
47 President, G. C. Ives.
48 President, Arthur B. Ferry; Secretary and Superintendent, H. P. Deming; Butter Maker, F. W. Moore.
49 President, etc., P. W. Turner & Co.
50 Butter Maker, John Johnson.
51 President, A. O. Thrall; Secretary, Mary C. Annis; Superintendent and Butter Maker, A. W. Annis.
52 P. J. Boland.
53 President, C. M. Johnson; Secretary, C. J. Dewey; Superintendent Frank Avery; Butter Maker, William Foster.
54 President D. Ellsworth Phelps; Secretary and Treasurer, I. N. Hayden.
55 President, E. Manchester & Sons.
56 President, Abel Child; Secretary, G. H. Sumner; Treasurer, L. A. Cutten; Superintendent, Abel Child.
57 Treasurer, James Case; Secretary and Butter Maker, J. M. Gladwin; Superintendent, S. A. Sisson.

	Average Amount of Surplus Butter.	What Pattern Churn Used.	Is It Satisfactory?	Is a Separator Used? If So, What Make?
1	None.	Square Box.		No.
2	None.	Box.	Yes.	National.
3	None.	Trunk.	Yes.	No.
4				
5	Very Little.	Square Box.		No.
6	None.	Davis Swing.		No.
7				
9	One-eighth.	Trunk.	Yes.	No.
10	None.	Swing.	Yes.	No.
11	None.	Square.	Yes.	Empire.
12	None.	Dasher Churn.		De Laval.
13	None.	Vt. Farm Matchless, Revolving.		No.
14	None.	Square Box.		No.
15	None.	Square Box, Fargo Butter Worker, Swing.		De Laval.

	Average Amount of Surplus Butter.	What Pattern Churn Used.	Is It Satisfactory?	Is a Separator Used? If So, What Make?
16	None.	Revolving.		No.
18	None.	Revolving Churn.		United States.
19	None.	Large Revolving.	Yes.	No.
20	None.			No.
21	None.	Blanchard Cylindrical.		No.
22	None.			
23	None.	Box.	Yes.	No.
24	Small amount.	Square Box.		No.
25	None.	Vt. Farm Square Box.		No.
26				No.
27	None.	Square Box.	Yes.	No.
28	None.	Improved Square. Box.	Yes.	No.
29	Some in June and May.	Trunk.	Yes.	No.
30	None.	Davis Swing.		No.
31	None.	Davis Swing.	Yes.	De Laval.
32	None.			De Laval.
33	None.	Barrel Churn.		No.
34	None.	Davis Swing.		No.
35	None.	Box Churn.		No.
36	None.	Square Box.		De Laval.
37	None.	Moseley & Stoddard.	Yes.	No.
38	None.	Davis Swing.	Fairly.	No.
39	None.	Blanchard.	Yes.	De Laval & U. S.
40	None.	Box Churn.	Yes.	No.
41	None.	Box Churn.	Very.	De Laval.
42	None.	Box Churn.	Yes.	De Laval, Alpha.
43	None.	Swing Churn.		No.
44	None.	Large Box Churn Revolving.	Yes.	De Laval.
45	None.	Swing Churn.	Yes.	No.
46	None.	Davis Swing.		No.
47	None.	Vt. Square Box.	Yes.	No.
48	3,000 lbs.	Vt. Square Box.	Yes.	De Laval.
49	None.	Stoddard.		De Laval.
50	None.	Blanchard Swing.	Yes.	Russian Imperial.
51	None.	Davis Swing.	Yes.	
52	None.	Davis Swing.		No
53	None.	Square Box.	Yes.	De Laval.
54	None.	Box Churn.	Yes.	No.
55	None	Barrel.	Yes.	De Laval.
56	Small Amonnt.	Davis Swing.		No.
57	None.	Square Box..	Yes.	De Laval.

	When Organized.	What System.	No. of Patrons.	No. of Cows.	Amount Butter made in 1898.
1	1887.	Babcock Test.	92		
2	1889.	Babcock Test.	114	800	142,504
3	1875.	Curtis Oil Test.	42	400	44,730
4					65,870
5	1879.	Babcock Test.	90	700	134,193
6	1888.	Babcock Test.	17	500	
7	1875.		12	105	16,311
8					
9	1886.	Babcock Test,	61	515	80,312
10	1887.	Babcock Test.	60	300	63,940
11	1895.	Babcock Test.	10	200	18,000
12		Babcock Test.	30	280	
13	1895.	Babcock Test.	59	500	100,318
14	1888.	Babcock Test.	43	200	
15	1882.	Babcock Test.	38	300	
16	1888.	Babcock Test.	50	350	
18	1882.	Babcock Test.	64		35,600
19	1884.	Babcock Test.	100	1,500	175,168
20					
21	1870.	Babcock Test.	33	300	
22	1886.	Space.	50		55,554
23	1890.	Babcock Test.	40	250–300	63,700
24	1883.	Babcock Test.	48		
25	1882.	Babcock Test.	160		96,155
26					
27	1877.	Space.	13	150	54,435
28	1888.	Space.	37		74,333
29	1887.	Babcock Test.	180	1,800	302,095
30	1886.	Babcock Test.	95		100,006
31	1887.			35	7,500
32	1885.	Babcock Test.	20	200	
33	1882.		120	500	
34	1889.	Babcock Test.	9	90	10,671
35	1882.		44	325	57,485
36	1889.	Babcock Test.	33	150	
37	1888.	Babcock Test.	54	300	75,950
38	1894.			14 to 18	6,000
39	1888.	Babcock Test.	34	200	43,104
40	1899.	Babcock Test.	61	600	80,016
41	1888.	Babcock Test.	66	600	96,000
42	1895.	Babcock Test.	60	400 to 500	78,000
43	1885.	Babcock Test.	26	250	
44	1888.	Babcock Test.	96	800	136,344
45	1888.	Babcock Test.	31	300	46,813
46			30	176	
47		Babcock Test.	81		
48	1889.	Babcock Test.	99	800	128,376
49	1889.	Babcock Test.	100	750	19,086

The Matthews-Northrup Up-to-Date Map of CONNECTICUT.

Also Published Indexed in Vest-Pocket Style.

Style of lettering indicates the character and relative importance of places as follows: ⊛ STATE CAPITAL; ◎ County Seat. Other places are graduated FROM GREAT Cities down through Big Towns and Important Villages, to Little Villages and mere Stations.

8½ MILES TO THE INCH.

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When Organized.		What System.	No. of Patrons.	No. of Cows.	Amount Butter made in 1898.
50	1885.	Babcock Test.	54	3,000	27,037
51	1889.	Babcock Test.	40		64,410
52	1889.	Babcock Test.	37		
53	1883.	Babcock Test.	108	1,000	177,499
54	1885.	Babcock Test.	60	460	98,239
55	1880.	Babcock Test.	3	90	
56	1880.		30	200	
57	1896.	Babcock Test.	75		88,335

EXPORT BUTTER TRADE.

The following table shows the amount of butter and cheese exported, by years, since 1894:

Year.	Butter.	Value.	Cheese.	Value.
1894.....	11,312,092	$2,077,608	73,852,134	$7,180,331
1895.....	5,598,812	915,533	60,448,421	5,497,539
1896.....	19,373,913	2,937,203	36,777,291	3,091,914
1897.....	31,345,224	4,493,364	50,944,617	4,636,068
1898.....	25,690,025	3,864,765	58,167,280	4,599,324

This butter has nearly all been of an inferior grade, and shipped without special care. Foreign merchants, for this reason, gained the impression that good butter could not be obtained in the United States. The Secretary of Agriculture in 1897 determined to make experimental exports of selected creamery butter, so that the erroneous opinions entertained by foreign butter buyers might be corrected.

The following is a list of shipments with date of export and names of Creameries at which butter was made especially for these trials:

Export.	Date.	Cremeries.
I.	May 5	College Creamery, State Agricultural Col., Ames, Ia. Diamond Creameries, Monticello, Iowa. Hillside Creamery, Cornish, N. H.
II.	May 26	College Creamery, Ames, Ia. Jersey Hill Creamery, Ryegate, Vt.
III.	June 16	Star Lake Creamery, Strout, Minn. Conway Creamery, Conway, Mass.
IV.	July 7	Hesston Creamery, Newton, Kans.
V.	July 28	Mt. Pleasant Co-operative Creamery, Mt. Pleasant, O. Bentley & Son's Creamery, Circleville, Ohio. Jensen Creamery Company, Beloit, Kans.
VI.	Aug. 25	Sennett Creamery, Sennett, N. Y. Edmund's Creamery, Sherman, N. Y. Hilton & Nimmo's Creamery, Knapps, N. Y.
VII.	Sept. 15	Hoards's Creameries, Fort Atkinson, Wis.
VIII.	Oct. 6	College Creamery, Ames, Iowa. Vernon Creamery, Rockville, Conn.
IX.	Oct. 27	Big Stone Creamery, Big Stone City, S. Dak. Star Lake Creamery, Strout, Minn.

The following shows the record of scoring of butter exported, and of foreign-made butter:

RECORD OF SCORING OF BUTTER EXPORTED.

Sample.			Scored.		Points and Scale.						Notes.
No.	Mark.	Where Made.	Where.	When.	Flavor, 40.	Body, 30.	Color, 10.	Salt, 10.	Package, 10.	Total, 100.	
1	P.	Conn.	NewYork,	Oct. 5	37	30	10	10	10	97	
2	P.	....do.....	London...	Oct. 16	36	28	8	8	10	90	Same as No. 1.
3	A.	Iowa.	Chicago ..	May 1	37	29	10	9.5	10	95.5	
4	A.	....do.	....do	May22	34	28	9.5	9.5	10	91	Same as No. 3.
5	A.	....do.....	....do	June 4	35	28	9	10	10	92	Do.
6	A.	....do.....	London...	May15	35	25	10	6	10	86	Do.
7	A.	....do.....	Chicago ..	May22	38.5	28.5	10	10	10	97	
8	A.	....do.....	....do	June 4	36.5	28.5	9.5	10	10	94.5	Same as No. 7.
9	A.	. ..do.....	NewYork,	Oct. 7	38	29	9.5	9.5	10	96	
10	A.	....do.....	....do	Nov.12	36.5	28	10	10	10	94.5	Same as No. 9.
11	H.	Kansas...	Chicago ..	July 2	33.5	29	9.5	10	10	92	Pasteurized.
12	H.	....do.....	....do	July 2	32.5	28	9.5	10	10	90	Raw cream.
13	H.	....do.....	NewYork,	July 7	33	30	9	10	10	92	Pasteurized same as No. 11.
14	H.	....do.....	....do	Aug.26	32	30	9	10	10	91	Do.
15	H.	....do.....	....do	July 7	31	29	8	10	10	88	Same as No. 12.
16	H.	....do.....	....do	Aug.26	30	29	8	10	10	87	Do.
17	H.	....do.....	London...	July19	38	27	10	9	9	93	Do.
18	J.	....do.....	Chicago ..	July27	36	29	10	10	10	95	Pasteurized.
19	J.	....do.....	....do	July27	35.5	28.5	10	10	10	94	Raw cream.
20	J.	....do	NewYork,	July29	36	29.5	10	10	10	95.5	Same as No. 18.
21	J.	....do	....do	Aug.26	35	29.5	10	10	10	94.5	Do.
22	J.	....do.	....do	Aug.26	31	30	10	10	10	91	Pasteurized. Box sent to London and back to New York.
23	J.	....do	....do	July29	35	30	10	10	10	95	
24	J.	....do	....do	Aug.26	34	30	10	10	10	94	Same as No. 23.
25	J.	....do	....do	Aug.26	31	30	10	10	10	91	Box exported to London and sent back to New York.
26	J.	....do.	London...	Aug. 7	33	27	8	8	10	86	Pasteurized.
27	J.	....do	....do	Aug. 7	31	27	8	6	10	82	Raw cream.
28	F.	Mass.....	Boston....	Jun.18	35	30	10	10	10	95	

Sample.			Scored.		Points and Scale.						Notes.
No.	Mark.	Where Made.	Where.	When.	Flavor, 40.	Body, 30.	Color, 10.	Salt, 10.	Package, 10.	Total, 100.	
29	F.	....do	NewYork,	Jun.28	35	29	10	10	10	94	Same as No. 28.
30	F.	....do	....do	July21	33	30	10	10	10	93	Do.
31	F.	....do	London...	July25	36	30	10	9	10	95	Do.
32	E.	Minn.	Minn.	Jun.17	38	29	9.5	9.5	10	96	
33	E.	....do	NewYork,	Jun.28	36.5	30	10	10	10	96.5	Same as No. 32.
34	E.	....do	London...	July14	35	30	10	9	10	94	Do.
35	E.	....do	Minn.....	Oct. 25	39	30	9.5	10	10	98.5	
36	E.	....do	NewYork,	Nov. 1	36	30	10	10	10	96	Same as No. 35.
37	E.	....do	....do	Nov.12	35	30	10	10	10	95	Do.
38	E.	....do	London...	Nov.14	35	28	10	9	10	92	Do.
39	C.	N. Hamp.	....do	May15	35	27	10	7	10	89	
40	K.	NewYork,	NewYork,	Aug.26	33	30	10	10	10	93	
41	K.	....do	London...	Sep.10	33	28	8	10	10	89	Same as No. 40.
42	L.	....do.	NewYork,	Aug.26	35	30	10	10	10	95	
43	L.	....do	London...	Sep.10	37	28	10	10	10	95	Same as No. 42.
44	G.	Ohio.....	Ohio.....	Aug.6	38	26	10	10	10	94	
45	G.	....do	NewYork,	July29	34	29	10	10	10	93	Same as No. 44.
46	G.	....do	....do	Aug.26	33	29	10	10	10	92	Do.
47	G.	....do	....do	Aug.26	30	29	10	10	10	89	Same lot. Returned from London.
48	G.	....do	London...	Aug. 7	32	24	8	8	10	82	Same as No. 47.
49	I.	....do	Ohio.....	Aug. 6	35	28	9	10	10	92	
50	I.	....do.	NewYork,	Aug. 2	32	29.5	10	10	10	91.5	
51	I.	....do	....do	Aug.26	28	29.5	10	10	10	87.5	Same as No. 50.
52	I.	....do	....do	Aug.26	31	29.5	10	10	10	90.5	Same lot, back from London.
53	I.	....do	London...	Aug. 9	26	18	8	7	10	69	Same as No. 52.
54	O.	So. Dak..	Madison..	Nov. 1	39	20	9.5	8	10	96.5	
55	O.	....do	NewYork,	Nov. 3	36	30	10	10	10	96	Same as No. 54.
56	O.	....do	London...	Nov.14	27	20	10	6	10	73	Do.
57	D.	Vermont.	Boston....	June 1	37	30	10	10	10	97	
58	N.	Wisc'ns..	Madison..	Sep.12	37	28	10	8	10	93	
59	N.	....do	NewYork,	Sep.16	35	30	10	10	10	95	Same as No .58.
60	N.	....do	London...	Sep.25	35	27	9	6	10	87	Do.
		Average of all 60 records.....			34¼	28½	9½	9½	10	91¾	
		Average of 45 records in U. S...			34¾	29	9¾	9¾	10	93¼	London omitted.

RECORD OF SCORING OF FOREIGN-MADE BUTTER.

Sample of Butter.			Scored.		Points and Scale.						Notes.
Number.	Where Made.	Form.	Where.	When.	Flavor, 40.	Body, 30.	Color, 10.	Salt, 10.	Package, 10.	Total, 100.	
1	Brittany, Fr ...	Fresh rolls; no salt.	NewYork	Jun. 28	36.5	30	10	10	10	96.5	
2	....do		....do	Nov. 3	35	30	10	10	10	95	
3	....do		Chicago ..	Nov.10	26	30	10	10	10	86	Same as No. 2.
4	....do		London...	Sep. 29	38	29	9	10	10	96	
5	Normandy, Fr.	Firkin.....	NewYork,	Jun. 28	31	29	10	10	10	90	
6	....do	....do	....do	Aug.26	29	29	10	10	10	88	Same as No. 5.
7	....do	Basket.....	....do	Nov. 3	33	30	10	10	10	93	
8	....do	....do	Chicago ..	Nov.10	27	30	9.5	10	10	86.5	Same as No. 7.
9	Denmark.....	Cask.....	NewYork,	Jun. 28	35	30	10	10	10	95	
10	....do	....do	....do	Nov. 3	35.5	30	9.5	10	10	95	
11	....do	....do	Chicago ..	Nov.10	28	30	9.5	10	10	87.5	Same as No. 10.
12	....do	Sealed tin ..	NewYork,	July21	33	30	10	10	10	93	
13	....do.	Cask.....	London...	July 25	37	30	10	10	10	97	
14	....do	....do	....do	Sept.29	37	28	9	9	10	93	
15	Dorset, Eng....	Keg.....	NewYork,	Jun. 28	30.5	29	10	9.5	10	89	
16	....do	....do	....do	Aug. 26	28	29	10	9.5	10	86.5	Same as No. 15.
17	Ire.(creamery).	Box.....	....do	Jun. 28	26	28.5	9.5	10	10	84	
18	....do.	Sealed tin..	....do	July 21	27	29	10	10	10	86	
19	....do	Box.....	....do	Nov. 3	34	29.5	10	10	10	93.5	
20	....do	....do	Chicago ..	Nov. 10	26	29	10	10	10	85	Same as No. 19.
21	Holland.....	Keg.....	NewYork,	Nov. 3	32.5	29.5	9.5	10	10	91.5	
22	....do	....do	Chicago ..	Nov. 10	24	30	8	10	10	82	Same as No. 21.
23	Finland	....do	NewYork,	Nov. 3	33	30	9.5	10	10	92.5	
24	....do	....do	Chicago ..	Nov. 10	24	28	8	10	10	80	Same as No. 23.
25	N. S. Wales....	Cub'l box...	NewYork,	Jun. 28	29	29	10	10	10	88	
26	New Zealand...	....do.	....do	Nov. 3	33	30	10	10	10	93	
27	. ..do	....do	Chicago ..	Nov. 10	24	30	10	10	10	84	Same as No. 26.

NOTES.

These are scores upon foreign butter, made in this country by American judges, upon an American basis. The general average of the 27 records is as follows: Flavor 30¾, body 29½, color 9¾, salt 10, package 10; total 90. This indicates that the imported butter was found in good condition upon examination in New York and Chicago, with the exception of flavor, which had deteriorated nearly 25 per cent. "Notes" indicate records of the same butter examined at different times and places. Seven lots of butter which averaged 93¼ points in New York on November 3 averaged 84¼ points in Chicago a week later; the main disparity was that the New York scores averaged 8 points higher on flavor. This was manifestly due to difference in judgment rather than actual change in the butter; the same judges varied but half a point (average) on the "body" of the same samples.

The only lots of these foreign butters which scored above 94 points in New York were the two Danish casks brought over in June and November and the fresh Brittany rolls imported at the same time.

AN ACT CONCERNING THE SELLING OF TUB BUTTER.

At the time this law was passed there was a large amount of cheap Western butter taken from the tubs here in Connecticut and pressed into prints and then put upon the market with an attractive wrapper marked with some fictitious name, so that the people who purchased it would think they were getting good Connecticut creamery butter. This was deceiving the public, hence the passage of this law. The general work under it has been fairly satisfactory. Nearly all dealers comply with its requirements. There is a good deal of butter in the State that has undoubtedly been printed from tubs, but a large part of this has been done outside of the State, and while under the law all retail dealers in the State who handle these goods are liable, it is very hard to get satisfactory proof, we having no authority outside the State. Thorough investigation has been made in all parts of the State as to the violation of this law.

AN ACT CONCERNING THE SELLING OF TUB BUTTER.

SECTION 1. No person by himself, or his agents or his servants, shall sell, offer for sale, or have in his possession with intent to sell, any butter known as "Tub Butter" which is pressed or printed into what is known as bricks, pats or balls, except under the following conditions: Every such brick, pat, or ball shall have the words

"Tub Butter" in one-half inch Roman letters, stamped or pressed upon it, and if wrapped, the wrapper shall be marked in like manner. It shall be the duty of the Dairy Commissioner to attend to the enforcement of this act throughout the State; and for this purpose the Commissioner and his deputy shall have free access at all reasonable hours to all places and premises where the Dairy Commissioner or his deputy suspects that any act in violation of this law has been or is being committed.

SEC. 2. Any person violating any provision of this act shall be fined not more than one hundred dollars.

Approved, May 5, 1897.

PROCESS, OR RENOVATED BUTTER.

The sale of process or renovated butter has become quite a factor in the butter trade in this State. Several large manufactories have been built within the past few years in different parts of the country for the manufacturing of this kind of butter. There is none of it made in this State, but it is shipped in here and sold in many places and often under deceptive names. Several States have within the last year enacted laws regulating its sale. One State requires it to be branded "Process Butter," one "Renovated, or Process Butter," and five other States require it to be branded "Renovated Butter." Under such laws as these consumers will have means of knowing what they are buying. The sale of this butter can do great harm to the dairy interests of our State and country. Efforts have also been made to establish its sale in foreign countries in the place of genuine American butter. This will be disastrous to the standing of pure butter in those markets. Some facts in regard to the making of this butter may be of interest. The following is from the report of the Hon. Levi Wells, Dairy and Food Commissioner of Pennsylvania, also the law regulating its sale enacted by the last Legislature of that State:

RENOVATED BUTTER.

(Extract from Annual Report of the Dairy and Food Commissioner for 1898.)

PENNSYLVANIA.

"It may be of interest to many to know what renovated butter is. It is also known under several alias, such as 'boiled' process and 'aerated' butter, and is produced from the lowest grade of butter that can be found in country stores or elsewhere. It is of such

poor quality that in its normal condition it is unfit for human food. It is generally rancid and often filthy in appearance, and of various hues in color, from nearly a snow white along the various shades of yellow up to the reddish cast, or brick color. It is usually packed in shoe boxes or anything else that may be convenient, without much regard to cleanliness or a favorable appearance in any way. The merchant is glad to get rid of it, with its unwholesome smell, from his premises at almost any price, usually expecting that it will find its way to some soap factory where it naturally belongs; but in this he is mistaken.

"We have in our State two extensive plants using large quantities of this original stock, and converting the same into what is often branded and sold for creamery butter. It is first dumped into large tanks surrounded with jackets containing hot water, and melted at a temperature ranging from 100 to 110 degrees Fahrenheit. After being thoroughly melted the heavier solids sink to the bottom and the lighter particles rise to the top, which, when skimmed off, leaves the clear butter fat with the heavier sediment at the bottom.

"This butter fat is then removed to other tanks, jacketed and surrounded with hot water like the first. The odor of the fat at this stage is anything but agreeable, and the main object of the next manipulation is to remove this stench from it. This is supposed to be accomplished by aeration, the fat passing out of a pipe at the bottom of the tank, and with a rotary pump it is again elevated in a pipe over the top of the tank, and discharged through a strainer into the same, thus, to remove the disagreeable odors, keeping up a continuous circuit and agitation of this liquid butter fat. It is claimed by some that chemicals are also used for this purpose; but I have been assured by parties who are engaged in the business that this is not true. When the fat is sufficiently aerated the machinery is changed by removing the funnel-shaped strainer, and large quantities of skim milk are added; in just what proportion I am unable to state, but can approximate very nearly the amount. An analysis of the finished product showed only 75 per cent. of butter fat, and as it contained nothing but the fat and milk and a small amount of salt, there must have been about 25 per cent of milk added. A perfect emulsion of the milk and butter fat is obtained by the same machinery that did the aerating, excepting the strainer, and it is accomplished in a very short time. When the milk has all disappeared the melted mass looks much as it did before the milk was added.

"It is next run off in pipes to a vat of ice and water, where it is quickly chilled, taking the granular form and looking like ordinary butter, when in the granular form before being worked. It is then worked, salted, if necessary, and printed or packed in tubs for shipment, often as fresh, creamery butter.

"I do not know how a greater fraud could be perpetrated upon

the unsuspecting consumer or upon legitimate dairy interests, than is done by these manufacturers of spurious butter. In the first place, twenty to twenty-five per cent. of the compound is skim milk, for which the consumer pays the price of butter. Besides this, the filthy condition of the foundation stock before any manipulation occurs, were it known, would deter most people from eating it. It certainly should only be allowed to be sold for what it is, namely, 'Renovated Butter.' It is a fraud because it has no keeping qualities. Being so heavily charged with skim milk, unless kept at a very low temperature, it soon becomes putrid. The manufacturer and jobber may get it off their hands before it deteriorates, but before it gets to the consumer, usually, 'its last estate is worse than its first.'

Respectfully submitted,

LEVI WELLS,

Dairy and Food Commissioner."

ACT RELATING TO "BOILED" OR "PROCESS" BUTTER.

PENNSYLVANIA.

AN ACT to regulate the sale of butter produced by taking original packing stock and other butter and melting the same, so that the butter oil can be drawn off, mixed with skim milk or other material and by emulsion and other process produce butter, and butter produced by any similar process, and commonly known as "boiled" or "process" butter; providing for the enforcement thereof and punishment for the violation of the same.

SECTION 1. Be it enacted, etc., that no person, firm, or corporate body shall, within this State, sell, or offer, or expose for sale, or have in his, her, or their possession with intent to sell, any butter not labelled in compliance with the provisions of this act. Butter produced by taking original packing stock and other butter and melting the same, so that the butter oil can be drawn off, mixed with skim milk or other material, and by emulsion or other process produce butter, and butter produced by any similar process, and commonly known as "Boiled" or "Process" butter, shall before sale, and before being offered or exposed for sale, and while in the possession of any person, firm, or corporate body with intent to sell the same, be plainly labelled "Renovated Butter," in the manner prescribed by this act. If sold, offered, or exposed for sale, or in possession of any person, firm or corporate body with intent to sell the same in prints or rolls, the prints or rolls shall be covered by wrappers, on which shall be printed in conspicuous letters the words "Renovated Butter." If packed in tubs or other receptacles, and sold or offered or exposed for sale, or held in the possession of any person, firm, or corporate body with intent to sell the same, the said words shall be printed in one inch letters on the top and two sides of

the tub or receptacle; if uncovered and not contained in a tub or other receptacle, and sold or offered or exposed for sale, or held in the possession of any person, firm, or corporate body with intent to sell the same, a placard containing the said words shall be attached to the mass, in a manner making them plain and prominent.

SEC. 2. Every person, firm, or corporate body who shall violate any of the provisions of this act shall, for every such offense, forfeit and pay not less than twenty-five dollars nor more than one hundred dollars, which shall be recoverable with costs, including expense of inspection and analysis, by any person suing in the name of the Commonwealth, as debts of like amount are by law recoverable: Provided, That the Department of Agriculture, through its officer known as the Dairy and Food Commissioner, together with the deputies, agents and assistants, shall be charged with the enforcement of this act, and shall have full access to all places of business, factories, buildings, carriages, cars, vessels, barrels, and packages of whatever kind, used in the manufacture and transportation and sale of any butter, or of any adulteration or imitation thereof. They shall also have power and authority to open any package, barrel or vessel containing any butter, or any adulteration or imitation thereof, which may be manufactured, sold, or offered or exposed for sale, or held in possession with intent of the holder to sell; and they shall also have full power and authority to take the samples therefrom for analysis, upon tendering the value of said samples. And all charges, accounts and expenses of the Department for the enforcement of this act, through the said commissioner and his deputies, agents, assistants, chemists and counsel employed by him in carrying out the provisions of this act, shall be paid by the Treasurer of the State in the same manner as other accounts and expenses of the said Department are paid. And all penalties and costs for the violation of the provisions of this act shall be paid to the said Dairy and Food Commissioner, or his agents, and by him immediately covered into the State Treasury.

SEC. 3. Every person who violates any of the provisions of this act shall be deemed guilty of a misdemeanor, and upon conviction thereof shall be punished by a fine of not more than one hundred dollars, or by imprisonment in the county jail for not more than thirty days, or both fine and imprisonment, for the first offense; and a fine or one hundred dollars and imprisonment for thirty days, for every subsequent offense: Provided, That all fines and costs, including the expense of inspection and analysis imposed under this section, shall be covered into the State Treasury, as provided by section two of this act; and all butter sold or offered or exposed for sale, or held in the possession of any one with intent to sell the same, in violation of the provisions of this act shall be subject to forfeiture and spoilation.

SEC. 4. Magistrates and justices of the peace throughout this

Commonwealth shall have jurisdiction to hear and determine actions arising for violations of the provisions of this act, and to hold for court or impose the penalties provided therein, subject to appeal as the law shall direct.

Approved—The 4th day of May, A. D. 1899.

WILLIAM A. STONE.

The foregoing is a true and correct copy of the act of the General Assembly, No. 121.

W. W. GRIEST,
Secretary of the Commonwealth.

VINEGAR.

The act relating to the manufacture and sale of vinegar has received our special attention, and from samples of vinegar collected in every section of the State, there should be encouragement for those who desire strictly pure cider vinegar to be sold and sold for what it truly is. There should also be encouragement for the maker of the high-grade article, owing to the advance in price of pure cider vinegar; also the ready sale for it.

A number of samples have been drawn from different sections of the State, and a very large per cent. of it is above the standard required by this act. According to the following table, which was returned from the Connecticut Agricultural Experiment Station, it shows that the acetic acidity runs from 2.20, the lowest, up to 6.59, the highest, and the solids found in the samples range from .11, the lowest, up to 4.32 and 4.78, the highest. Of the one hundred and seventy-five samples examined prosecutions have followed in eighteen cases, and in nearly every instance the parties prosecuted pleaded guilty and settled in court by paying fines of $10 and costs. Thirteen of the eighteen cases prosecuted were found in the city of New Haven, where was discovered a flagrant violation of the law by a New York agent, who was selling a low grade white wine, or malt vinegar, with a coloring material, for a "pure cider vinegar." The prosecution and conviction which followed has driven him out of business. There has recently been discovered a "vinegar essence," which is being imported into the country from Germany and is being placed upon the market in bottles of different sizes. A half-pint bottle is advertised to make four gallons of

pure cider vinegar. This is one of the new things which will claim the attention of this department in the future. Eternal vigilence is the motto for pure foods of all kinds, owing to the sharp competition in trade.

We can again say that the present vinegar law is a complete success, and, as ever, it will be the aim of this department to enforce the law making it beneficial to both producer and consumer of the pure article.

The objects of this law will be briefly reviewed, and, as amended in its first section, forbids under penalty the sale of anything as cider vinegar which is not produced wholly from the juice of apples, as well as the addition of any color, adutlerant, or drug, other than acetic acid, to vinegar of any kind.

The second section forbids the making for sale, or the sale by the maker, of vinegar having less of acetic acidity than the equivalent of 4 per cent. of absolute acetic acid, as well as the sale of cider vinegar having less than 2 per cent. of solids. It also provides that no vinegar shall be sold without a conspicuous label on the head of the inclosing package giving the maker's name and the place of manufacture. The words "cider vinegar" must also be added to this label of cider vinegar in the package. This clause regarding marking does not apply to vinegar sold at retail in less than five gallon quantities in open packages at the place of manufacture. The first violation of this section is punishable by a fine of ten dollars, the second or later violation by fifty dollars fine.

The third section makes it illegal to sell, offer, or expose for sale or to solicit or receive any order for the sale or delivery within the State, of any vinegar, the sale of which is prohibited by sections 1 and 2, and providing that the delivery of any such vinegar on an order received or solicited within the State shall be conclusive evidence that this order was for such vinegar, and shall render the solicitor or receiver of the order liable to a fine of ten dollars for a first offense and of fifty dollars for a second or later offense.

The fourth and fifth sections relate to the Dairy Commissioner's duties in enforcing the law and prescribing a penalty for refusing to admit him to places of business, or to sell him samples of vinegar.

The law then forbids the sale: 1. Of anything as vinegar to which coloring or any foreign substance except acetic acid,

and of anything as vinegar which contains less than 4 per cent. of absolute acetic acid. 2. Of anything as cider vinegar which is not made wholly of apple juice, or which contains less than 2 per cent. of solids, or which is not, when sold in quantities of more than five gallons or elsewhere than at the place of manufacture, distinctly labelled "cider vinegar."

Hence the law was drawn for two objects: First, to prevent the sale, under the name of cider vinegar, of vinegar made from wine, whiskey, or malt, or consisting chiefly of diluted acetic acid to which some cider vinegar had been added; and, second, to stop the sale of adulterated, inferior, or so-called weak vinegar.

Since the passage of this act the vinegar throughout the State is constantly being brought up to a higher standard of quality and purity, and there is a general desire on the part of dealers in vinegar to obey and fully comply with the law in its provisions.

Not all the samples that have been collected were sent to the Experiment Station, as several of them were given a preliminary test in the office by your Commissioner and if found not suspicious were passed by.

LAW IN RELATION TO THE MANUFACTURE AND SALE OF VINEGAR.

SECTION. 1. No person shall make and sell, or make for sale, as cider vinegar, any vinegar not produced wholly from the juice of apples. No person shall add to any vinegar or to any article sold or to be sold as vinegar, any drug, any hurtful or foreign substance, any coloring matter, or any acid. Any person violating this section of this act shall be fined fifty dollars for a first offense, and for a second or later offense he shall be fined one hundred dollars and imprisoned thirty days.

SEC. 2. No person shall make and sell, or make for sale, any vinegar not having an acetic acidity equivalent to the presence therein and not less than four per centum by weight, of absolute acetic acid, and in case of cider vinegar, not less than two per centum by weight of cider vinegar solids upon full evaporation over boiling water. No maker of vinegar shall sell the same without conspicuously branding, stenciling, or painting upon the head of the barrel, cask, keg or package containing the same, the name of the maker, his residence or place of manufacture, and the true name of the kind of vinegar contained therein as "cider vinegar," "wine vinegar," "malt vinegar," or "wood acid vinegar;" provided that this clause concerning marking shall not apply to retail sales, at the place of manufacture, in quantities of less than five gallons, and in

open packages. Any person violating this section of this act shall be fined ten dollars for a first offense, and for a second or later offense fifty dollars.

SEC. 3. No person shall sell, or offer, or expose for sale or exchange, or solicit, or receive any order for the sale or delivery within this State, or for delivery without this State for shipment into this State: first, any vinegar, as cider vinegar, not wholly produced from the juice of apples; or second, any vinegar, or article sold, or to be sold as vinegar, in which has been added any drug, or any hurtful or foreign substance, or any coloring matter, or any acid; or third, any vinegar not having an acetic acidity equivalent to the presence therein of not less than four per centum by weight of absolute acetic acid, and in case of cider vinegar, not less than two per centum by weight of cider vinegar solids upon full evaporation over boiling water; or fourth, any vinegar in a barrel, cask, keg, or other package not branded, stenciled, or painted as required by a previous section of this act. Any person violating this section of this act shall be fined ten dollars for a first offense, and for a second, or later offense fifty dollars. The delivery of any of the above-mentioned articles upon any order solicited or received within this State shall be conclusive evidence that the order upon which such delivery was made was for such articles, and shall render the person soliciting or receiving such order liable to the penalty above prescribed.

SEC. 4. It shall be the duty of the Dairy Commissioner to attend to the enforcement of this act: and for the purpose of examining into suspected violations thereof, he shall at all reasonable hours have free access to all places and premises where he suspects that any provision of this act is violated, and on tender of the market price of good vinegar therefor, he may take from any person, firm, or corporation, samples of vinegar which he suspects of being made or sold in violation of this act; and he may himself analyze such samples, or have such samples analyzed by any State chemist, or by the Experiment Station; and a sworn or affirmed certificate by such analyst shall be *prima facie* evidence of the ingredients and constituents of the sample analyzed; and if such analysis shall show that such sample does not conform to any requirement of this act, and shall give the Dairy Commissioner reasonable ground for the belief that any provision of this act has been violated, he shall make complaint to the proper prosecuting officer, to the end that the violator may be prosecuted.

SEC. 5. Any person refusing the Dairy Commissioner, or his deputy, access, in a reasonable manner and at a reasonable time, for said purpose of examination, or refusing to sell samples, as hereinbefore provided, shall be fined not more than seven dollars or imprisoned not more than thirty days, or both. Evidence of any violation of this act shall be *prima facie* evidence of willful violation with knowledge.

Approved, March 29, June 21, 1889.

The following is a list of some of the samples taken in the year and the result of the analysis by the Agricultural Experiment Station :

No.	Kind.	Solids per cent.	Acidity per cent.
III.		4.78	3.38
1	Cider Vinegar,	2.36	4.20
2	Cider Vinegar,	1.84	4.36
3	Cider Vinegar,	2.09	4.09
4	Cider Vinegar,	2.01	3.90
5	Cider Vinegar,	2.48	4.19
6	Cider Vinegar,	2.11	4.33
7	Cider Vinegar,	1.47	5.25
8	Cider Vinegar,	2.45	4.56
9	Cider Vinegar,	1.62	3.83
10	Cider Vinegar,	3.53	4.59
11	Malt Vinegar,	1.62	4.53
12	Cider Vinegar,	2.14	4.04
13	Cider Vinegar,	2.02	2.57
14	Cider Vinegar,	1.99	3.48
15	Cider Vinegar,	2.15	4.50
16	Cider Vinegar,	2.44	4.19
17	Cider Vinegar,	1.86	4.16
18	Cider Vinegar,	2.14	3.94
19	Cider Vinegar,	2.12	4.26
20	Cider Vinegar,	4.14	4.12
21	Cider Vinegar,	1.87	4.47
22	Cider Vinegar,	1.62	4.14
23	Cider Vinegar,	2.02	4.04
24	Cider Vinegar,	2.25	3.86
25	Cider Vinegar,	3.04	3.99
26	Cider Vinegar,	1.98	3.64
27	Cider Vinegar,	2.31	4.31
28	Cider Vinegar,	2.93	4.50
29	Cider Vinegar,	1.83	4.06
30	Cider Vinegar,	2.15	3.91
31	Cider Vinegar,	1.80	4.21
32	Cider Vinegar,	1.98	6.59
33	Cider Vinegar,	1.75	3.57
34	Cider Vinegar,	2.44	4.75
35	Cider Vinegar,	3.54	5.34
36	Cider Vinegar,	.33	4.70
37	Cider Vinegar,	3.17	3.79
38	Cider Vinegar,	1.99	5.94
39	Cider Vinegar,	2.14	4.65
40	Cider Vinegar,	1.85	5.01
41	Cider Vinegar,	1.79	4.75
42	Cider Vinegar,	1.50	3.98

No.	Kind.	Solids per cent.	Acidity per cent.
43	Cider Vinegar,	3.29	4.06
44	Cider Vinegar,	2.12	2.87
45	Cider Vinegar,	2.97	4.45
46	Cider Vinegar,	1.67	4.71
47	Cider Vinegar,	2.48	4.35
48	Cider Vinegar,	1.46	3.68
49	Cider Vinegar,	3.35	4.27
50	Cider Vinegar,	2.08	4.00
51	Cider Vinegar,	1.74	4.61
52	Cider Vinegar,	1.66	4.35
53	Cider Vinegar,	2.79	4.39
54	Cider Vinegar,	2.00	4.15
55	Cider Vinegar,	3 00	4.53
56	Cider Vinegar,	2.85	4.49
57	Cider Vinegar,	3.58	4.15
58	Cider Vinegar,	2.51	4.07
59	Cider Vinegar,	2.98	2.91
60	Cider Vinegar,	2.36	3.82
61	Cider Vinegar,	1.83	4.06
62	Cider Vinegar,	1.71	4.98
63	Cider Vinegar,	1.59	3.84
64	Cider Vinegar,	1.72	3.74
65	Malt Vinegar,	2.11	4.39
66	Malt Vinegar,	1.40	4.57
67	Cider Vinegar,	3.05	4.17
68	Cider Vinegar,	2.85	3.98
69	Cider Vinegar,	2.51	3.96
70	Cider Vinegar,	2.60	3.84
71	Cider Vinegar,	3.27	4.21
72	Cider Vinegar,	1.44	3.26
73	Cider Vinegar,	2 92	4.45
101	Cider Vinegar,	3.46	4.55
102	Cider Vinegar,	2.83	4.33
103	Cider Vinegar,	3.08	4.09
104	Cider Vinegar,	1.86	4.57
105	Cider Vinegar,	1.93	2.51
106	White Wine Vinegar.	.28	5.10
107	Cider Vinegar,	2.60	4.37
108	Cider Vinegar,	1.52	4.31
109	Cider Vinegar,	2.73	4.57
110	Cider Vinegar,	1.29	4.15
111	Cider Vinegar,	1.27	2.20
112	White Wine Vinegar,	.28	4.45
113	Cider Vinegar,	1.61	3.28
114	Cider Vinegar,	2.18	4.25
115	Cider Vinegar,	2.71	4.41
116	Cider Vinegar,	2 38	4.15

No.	Kind.	Solids per cent.	Acidity per cent.
117	Cider Vinegar,	1.36	6.03
118	Cider Vinegar,	4.14	5.08
119	Cider Vinegar,	2.05	4.27
120	White Wine Vinegar,	.17	4.35
121	Cider Vinegar,	2.06	5.36
122	Cider Vinegar,	1.71	4.35
123	Cider Vinegar,	.25	4.39
124	Cider Vinegar,	2.25	4.61
125	Cider Vinegar,	.15	3 96
126	White Wine Vinegar,	.16	4.73
127	Cider Vinegar,	2.26	3.86
128	Cider Vinegar,	2.71	4.53
129	Cider Vinegar,	2.22	3.80
130	Cider Vinegar,	2.19	4.31
131	Cider Vinegar,	.18	4.31
132	Cider Vinegar,	.16	4.91
133	Cider Vinegar,	.25	4.57
134	Cider Vinegar,	.13	3.92
135	Cider Vinegar,	.17	3.78
136	Cider Vinegar,	.16	3.90
137	Cider Vinegar,	.27	4.27
138	Cider Vinegar,	1.91	4.05
139	Cider Vinegar,	1.86	5.97
140	Cider Vinegar,	2.33	3.93
141	White Wine Vinegar,	.27	4.17
142	Cider Vinegar,	1.82	3.62
143	Cider Vinegar,	3.68	4.49
144	Cider Vinegar,	2.84	5.24
145	Cider Vinegar,	.25	4.34
146	Cider Vinegar,	1.95	4.11
147	Cider Vinegar,	1.42	4.24
148	Cider Vinegar,	1.21	4.54
149	Cider Vinegar,	1.57	3.40
150	Cider Vinegar,	.11	4.85
151	Cider Vinegar,	.22	4.25
152	Cider Vinegar,	2.81	3.92
153	Cider Vinegar,	.16	3.31
154	Cider Vinegar,	2.26	3.90
155	Cider Vinegar,	.18	4.77
156	Cider Vinegar,	.17	4.46
157	Cider Vinegar,	.20	4.61
158	Cider Vinegar,	2.64	5.47
159	Cider Vinegar,	1.88	5.05
160	Cider Vinegar,	3.77	3.39
161	Cider Vinegar,	2.18	4.07
162	Cider Vinegar,	3.27	3.86
163	Cider Vinegar,	2.14	4.74

No.	Kind.	Solids per cent.	Acidity per cent.
164	Cider Vinegar,	2.25	6.22
165	Cider Vinegar,	1.67	4.40
166	Cider Vinegar,	2.41	5.01
167	Cider Vinegar,	1.82	3.72
168	Cider Vinegar,	2.39	4.02
169	Cider Vinegar,	1.29	4.74
170	Cider Vinegar,	3.34	3.89
171	Cider Vinegar,	3.16	4.22
172	Cider Vinegar,	2.70	4.33
173	Cider Vinegar,	3.01	4.53
174	Cider Vinegar,	2.15	4.32
175	Cider Vinegar,	1.69	5.88
176	Cider Vinegar,	2.19	6.00
177	Cider Vinegar,	2.83	4.51
178	Cider Vinegar,	2.06	4.35
179	Cider Vinegar,	2.81	3.98
180	Cider Vinegar,	1.80	6.62
181	Cider Vinegar,	2.48	4.55
182	Cider Vinegar,	2.45	4.46
183	Cider Vinegar,	2.24	4.43
184	Cider Vinegar,	3.05	3.99
185	Cider Vinegar,	2.35	4.07
186	Cider Vinegar,	2.49	4.80
187	Cider Vinegar,	2.03	5.58
188	Cider Vinegar,	2.35	2.70
189	Cider Vinegar,	1.99	4.94
190	Cider Vinegar,	1.77	4.02
191	Cider Vinegar,	1.58	3.15
192	Cider Vinegar,	4.32	3.43
193	Cider Vinegar,	2.71	4.27
194	Cider Vinegar,	2.38	4.35
195	Cider Vinegar,	1.74	4.15
196	Cider Vinegar,	2.37	3.94
197	Cider Vinegar,	2.82	4.45
198	Cider Vinegar,	1.56	6.32
199	Cider Vinegar,	1.95	4.19
200	Cider Vinegar,	1.96	4.32

MOLASSES.

The law relating to the sale of molasses is one of general interest throughout the State. It is an article of consumption in nearly every family, and no one wishes to be be imposed upon by having cheap adulterated goods sold to them in place of that

which is pure and straight. There has been thorough investigation under this law made in all parts of the State during the year. Every city has been visited and a great many country stores. The molasses offered for sale in all of these places has been examined and a good many samples have been taken and forwarded to the Experiment Station for analyses. Quite a number of cases have been found where adulterated goods were offered for sale. We have had thirty-seven prosecutions. In many of the cases parties have plead guilty. The list given shows where the samples were taken and the analyses returned by the chemists. In some instances the dealers may have purchased the adulterated article innocently; others undoubtedly knew what they were offering for sale by the lower price which they paid for it. The stock of every wholesale dealer in the State has been examined and tested, and they are nearly all carrying pure, high-grade goods. Most of that which is adulterated is sold by agents from New York or Providence houses. Most of this work has to be done in the winter, and the coming season work under this law will be vigorously carried on. There is a good deal of molasses offered for sale that is of a very poor quality, although it may not be adulterated with glucose or some other foreign material. The saccharine matter has largely been extracted and its sweetening qualities thereby lowered. In some instances it is reduced in quality by the addition of some cheap syrup.

The following is received from the Hon. J. D. Dewell of New Haven, who is a large wholesale dealer and one who is thoroughly conversant with all facts connected with the trade:

PURE MOLASSES VS. MIXED.

The present statute is not sufficient for full protection to consumers of molasses. Glucose is easily detected, but when sugar syrup (whether from beet or cane) is mixed with molasses it can only be known by the low test of strength. We are aware that much of the so-called molasses now on sale in the State is a mixture of pure molasses and refined syrup, which may not be deleterious to health, yet is a fraud on the consumer. Syrup may be used on the table for griddle cakes, and the like, but is a poor substitute for cookery, as every housewife knows. Low-grade syrup is sold at a much less price than pure molasses can be imported, hence the temptation to use it as an adulterant of the latter. The Government places a duty on foreign molasses

of three cents per gallon if the polariscope strength is under 56°, and six cents if 56° or over; as a matter of fact, the molasses imported through the New Haven Custom House will test the average of 54°; much of the mixed will test no more than 40°.

An act should be passed at the next session of the Legislature establishing a test of not less than 50° on all molasses, sold as such, whether it be a foreign or domestic product. It became necessary to establish by law a minimum strength for vinegar; the time has now come when a standard should be adopted for molasses.

LAW IN RELATION TO THE SALE OF MOLASSES.

SECTION. 2620. It shall be the duty of the Dairy Commissioner to attend to the enforcement of the law against the adulteration of molasses and the sale of adulterated molasses, and, for the purposes of examining into suspected violations of such law, he shall, at all reasonable hours have free access to all places and premises where he suspects that molasses is adulterad or adulterated molasses is sold, and on tender of the market price of good molasses for the same, he may take from any person, firm, or corporation samples of molasses which he suspects is adulterated, and he may have samples of molasses suspected to be adulterated analyzed by any State chemist, or by the Experiment Station, and a sworn or affirmed certificate of such analyst shall be *prima facie* evidence of the ingredients and constituents of the samples analyzed; and if such analysis shall show that the molasses is adulterated, he shall make complaint to the proper prosecuting officer, that the person or persons who adulterated said molasses, or sold or exposed for sale such adulterated molasses, may be prosecuted.

SEC. 2621. Any person refusing the Dairy Commissioner or his deputy access, in a reasonable manner, and at a reasonable time for said purpose of examination, or refusing to sell samples, as hereinbefore provided, shall be fined not more than seven dollars, or imprisoned not more than thirty days, or both.

SEC. 2622. Any person who shall adulterate any molasses, or who shall sell, or offer or expose for sale, or who shall solicit or receive any order for the sale or delivery within this State, or for delivery without this State for shipment into this State, of any molasses adulterated with salts of tin, terra alba, glucose, dextrose, starch, sugar, corn syrup, or other preparation of, or from starch, shall be fined not more than five hundred dollars, or imprisoned not more than one year, or both. The delivery of any of the above-mentioned preparations, upon any order solicited or received within this State, shall be conclusive evidence that the order, upon which such delivery was made, was for such articles, and shall render the person soliciting or receiving such order liable to the penalty above described.

Approved, June 21, 1889.

The following is the analysis of a portion of the samples taken in different parts of the State:

* Signifies adulterated.

No.	Direct Polarization Sugar Degrees.	POLARIZATION AFTER INVERSION. Sugar Degrees.	At Tem. of.	Sugar Degrees. at 86° C.	Kind of Molasses.	Retail or Wholesale.	County.
1	42.6				Porto Rico,	Retail,	New Haven.
2	30.0				Porto Rico,	Retail,	"
3	52.0	—13.2	25		Porto Rico,	Retail,	"
4	30.4				Porto Rico,	Retail,	"
*5	93.7	74.3		76.8	Ponce,	Retail,	"
6	34.6				New Orleans,	Wholesale,	Hartford,
7	41.6				New Orleans,	Wholesale,	"
8	40.4				New Orleans,	Wholesale,	New London.
9	34.0				Porto Rico,	Wholesale,	"
*10	56.0	11.8	25	24.8	New Orleans,	Wholesale,	"
11	37.6				New Orleans,	Retail,	"
12	38.0				New Orleans,	Retail,	"
13	37.0				New Orleans,	Retail,	"
14	39.4				New Orleans,	Retail,	"
15	45.2	—11.0	25		New Orleans,	Retail,	"
16	60.0	8.8	25		New Orleans,	Retail,	"
17	36.0				New Orleans,	Retail,	"
18	47.2				Porto Rico,	Retail,	"
19	42.0				New Orleans,	Retail,	"
20	59.0	6.2	23		New Orleans,	Retail,	"
21	55.0	5.3	23		New Orleans,	Retail,	"
22	22.4				New Orleans,	Retail,	Hartford.
*23	87.6	63.4	24	64.6	Porto Rico,	Retail,	"
24	38.8				Porto Rico,	Retail,	"
25	38.2				New Orleans,	Retail,	"
26	44.8				Porto Rico,	Retail,	"
*27	119.0	106.3	24	114.4	New Orleans,	Retail,	"
*28	94.0	69.5	24	76.8	Porto Rico,	Retail,	"
29	46.0				New Orleans,	Retail,	"
30	45.4				Porto Rico,	Retail,	"
31	32.0				Porto Rico,	Retail,	"
32	40.8				New Orleans,	Retail,	Windham.
33	38.8				New Orleans,	Retail,	"
34	39.2				New Orleans,	Retail,	"
35	32.8				New Orleans,	Retail,	"
36	46.0				New Orleans,	Retail,	"
*37	80.0	37.4	22	44.6	Porto Rico,	Retail,	"
*38	71.0	19.8	22	25.0	New Orleans,	Retail,	"

No.	Direct Polarization Sugar Degrees.	POLARIZATION AFTER INVERSION. Sugar Degrees.	At Tem. of.	Sugar Degrees at 86° C.	Kind of Molasses.	Retail or Wholesale.	County.
39	27.0				Porto Rico,	Retail,	Windham.
40	41.0				New Orleans,	Retail,	"
41	69.0	16.5	22		New Orleans.	Retail,	"
42	47.0				New Orleans,	Retail,	"
43	42.8				New Orleans,	Retail,	"
44	51.0	—15.4	25		New Orleans,	Retail,	"
45	40.8				New Orleans,	Retail,	"
46	44.2				New Orleans,	Retail,	New Haven.
47	50.0	—13.2	22		Porto Rico,	Retail,	"
48	43.0				New Orleans,	Retail,	"
49	20.0				Ponce,	Retail,	"
50	46.0				New Orleans,	Retail,	Windham.
*51	109.2	75.4	24	72.0	Porto Rico,	Retail,	"
52	40.0				New Orleans,	Retail,	"
53	40.0				New Orleans,	Retail,	"
54	50.6	—11.0	19		Porto Rico,	Retail,	"
55	26.8	—18.5	19		New Orleans,	Retail,	"
*56	70.0	21.2	24	32.8	Porto Rico,	Retail,	"
57	28.4				New Orleans,	Retail,	"
*58	79.0	34.2	24	42.0	Porto Rico,	Retail,	"
59	30.0				New Orleans,	Retail,	"
60	38.0				New Orleans,	Retail,	"
61	40.8				New Orleans,	Retail,	"
*62	99.3	66.6	24	69.2	Porto Rico,	Retail,	"
63	33.4				New Orleans,	Retail,	"
64	43.6				Porto Rico,	Retail,	"
65	39.0				New Orleans,	Retail,	"
66	44.0				Porto Rico,	Retail,	"
67	47.2				New Orleans,	Retail,	"
68	42.4				Porto Rico,	Retail,	"
69	39.4				New Orleans,	Retail,	"
70	46.2				Porto Rico,	Retail,	"
*71	79.0	38.0	24	45.2	Porto Rico,	Retail,	"
72	40.6				New Orleans,	Retail,	"
*73	74.6	14.4	24	26.6	New Orleans,	Retail,	"
74	39.8				Porto Rico,	Retail,	"
*75	93.2	59.0	24	61.2	New Orleans,	Retail,	"
76	47.0				New Orleans,	Retail,	"
77	37.0				Porto Rico,	Retail,	"
78	42.4				New Orleans,	Retail,	Hartford.
79	36.0				Porto Rico,	Retail,	"
80	45.0				New Orleans,	Retail,	"

No.	Direct Polarization Sugar Degrees.	POLARIZATION AFTER INVERSION. Sugar Degrees.	At Tem. of	Sugar Degrees at 86° C.	Kind of Molasses.	Retail or Wholesale.	County.
*81	58.0	22.8	24	33.6	Porto Rico,	Retail,	Hartford.
82	37.0				New Orleans,	Retail,	"
*83	52.4	13.0	25	25.0	Ponce,	Retail,	"
*84	116.8	93.4	25	87.0	Porto Rico,	Retail,	"
85	49.6				Porto Rico,	Retail,	Windham.
86	37.6				Porto Rico,	Retail,	"
*87	78.6	35.0		43.8	Porto Rico,	Retail,	"
88							
*89	105.0	78.2		79.6	Porto Rico,	Retail,	"
90	30.4				New Orleans,	Retail,	"
91	41.6				New Orleans,	Retail,	"
92	42.2				New Orleans,	Retail,	"
93	44.0	—11.2		5.6	Porto Rico,	Retail,	"
94	38.6				New Orleans,	Retail,	"
95	42.2				New Orleans,	Retail,	"
*96	76.0	21.		34.6	New Orleans,	Retail,	"
97	39.6				Porto Rico,	Retail,	"
*98	61.6	15.		28.4	New Orleans,	Retail,	"
99	47.0				New Orleans,	Retail,	"
101	42.0				New Orleans,	Retail,	New Haven.
102	50.0	—13.6	23		Ponce,	Retail,	"
103	28.0	—16.7	20		New Orleans,	Retail,	"
104	50.0	—15.4	19		New Orleans,	Retail,	"
105	47.0				New Orleans,	Retail,	"
106	45.0				New Orleans,	Retail,	"
107	44.0				New Orleans,	Retail,	"
108	50.0	—14.5	19		Ponce,	Retail,	"
109	49.0	—13.6	19		New Orleans,	Retail,	Litchfield.
110	38.2				Porto Rico,	Retail,	"
112	41.2				New Orleans,	Retail,	New Haven.
113	51.0	—16.1	23		Porto Rico,	Retail,	"
114	50.0	—13.2	19		Porto Rico,	Retail,	"
115	52.0	—12.3	19		Porto Rico,	Retail,	"
116	43.0				Ponce,	Retail,	"
117	50.0	—12.5	19		New Orleans,	Retail,	"
118	42.0				New Orleans,	Retail,	"
119	48.0				Ponce,	Retail,	"
120	47.0				Ponce,	Retail,	"
121	37.2				New Orleans,	Retail,	"
122	51.6	—15.4	21		Ponce,	Retail,	"
123	53.0	—17.6	21		New Orleans,	Retail,	"
124	40.0				New Orleans,	Retail,	"

No.	Direct Polarization Sugar Degrees.	POLARIZATION AFTER INVERSION. Sugar Degrees.	At Tem. of.	Sugar Degrees at 86° C.	Kind of Molasses.	Retail or Wholesale.	County.
125	30.4				New Orleans,	Retail,	New Haven.
126	51.6	—13.6	21		Ponce,	Retail,	"
127	33.6				Ponce,	Retail,	Fairfield.
*128	110.6			87.8	New Orleans,	Retail,	"
129	42.8				Ponce,	Retail,	"
130	42.8				New Orleans,	Retail,	"
131	46.4				Ponce,	Retail,	"
132	36.6				New Orleans,	Retail,	"
133	39.8				Ponce,	Retail,	"
134	40.6				Ponce,	Retail,	Litchfield.
135	52.2				Ponce,	Retail,	"
136	38.0				New Orleans,	Retail,	"
137	41.2				New Orleans,	Retail,	"
138	50.0				Ponce,	Retail,	"
139	64.8				New Orleans,	Retail,	"
140	49.2				Ponce,	Retail,	"
141	30.4				Ponce,	Retail,	"
*142	90 0				New Orleans,	Retail,	Fairfield.
143	50.0				Ponce,	Retail,	"
144	37.2				New Orleans,	Retail,	"
145	45.0				Ponce,	Retail,	"
146	43.0				New Orleans,	Retail,	"
147	48.0				Ponce,	Retail,	"
148	78.0				New Orleans,	Retail,	"
149	44.0				Ponce,	Retail,	"
*150	74.6				New Orleans,	Retail,	"
*151	105.2				Ponce,	Retail,	"
200	78.6	35.0		46.0	Porto Rico,	Retail,	Windham,
201	40.4				New Orleans,	Retail,	"
*202	108.6	84.9		88.0	Porto Rico,	Retail,	"
203	40.0				New Orleans,	Retail,	"
*204	98.8	69.8		72.2	New Orleans,	Retail,	"
*205	106 8	86.6		88.2	Porto Rico,	Retail,	"
206	38.6				New Orleans,	Retail,	New London.
207	38.8				New Orleans,	Retail,	"
*208	79.4	34.8		44.9	Porto Rico,	Retail,	"
209	39.6				New Orleans,	Retail,	"
210	38.2				New Orleans,	Retail,	"
211	32.4				New Orleans,	Retail,	"
212	45.8				Porto Rico,	Retail,	"
213	33.4				New Orleans,	Retail,	"
214	38.0				New Orleans,	Retail,	"

No.	Direct Polarization Sugar Degrees.	POLARIZATION AFTER INVERSION. Sugar Degrees.	At Tem. of.	Sugar Degrees at 86° C.	Kind of Molasses.	Retail or Wholesale.	County.
215	41.6				New Orleans,	Retail,	Litchfield.
216	49.0				Porto Rico,	Retail,	"
217	48.8				Porto Rico,	Retail,	"
218	41.0				New Orleans,	Retail,	"
219	38.2				New Orleans,	Retail,	"
*220	100.6	80.0		81.0	Porto Rico,	Retail,	"
221	48.0				Porto Rico,	Retail,	"
222	35.8				New Orleans,	Retail,	"
223	49.6				Porto Rico,	Retail,	"
224	33.0				New Orleans,	Retail,	"
225	52.0				Porto Rico,	Retail,	"
226	53.8	—20		15.6	New Orleans,	Retail,	"
227	49 2				New Orleans,	Retail,	"
228	50.6				Porto Rico,	Retail,	"
*229	112.6	87.3		87.6	Porto Rico,	Retail,	Hartford.
230	38.0				Porto Rico,	Retail,	"
*231	53.8	26.0		38.2	Porto Rico,	Retail,	"
*232	88.2	61.4		65.0	Porto Rico,	Retail,	"
233	22.8				New Orleans,	Retail,	Tolland.
234	35.6				New Orleans,	Retail,	"
235	37.6				New Orleans,	Retail,	"
236	42.6				Porto Rico,	Retail,	"
237	34.2				New Orleans,	Retail,	"
238	47.0				Ponce,	Retail,	"
*239	107.0				Porto Rico,	Retail,	Windham.
240	42.8				Porto Rico,	Retail,	"
241	50.0				New Orleans,	Retail,	"
242	50.0				New Orleans,	Retail,	"
243	40.0				Porto Rico,	Retail,	"
244	41.4				New Orleans,	Retail,	"
245	50.0				Porto Rico,	Retail,	"
246	37.0				New Orleans,	Retail,	"
247	52.6				Porto Rico,	Retail,	"
248	42.8				New Orleans,	Retail,	"
249	49.0				Porto Rico,	Retail,	"
250	35.0				New Orleans,	Retail,	"
251	42.4				New Orleans,	Retail,	"
256	—5.6	—18.3		27.0	Porto Rico,	Retail,	"

THE LAW RELATING TO THE MANUFACTURE AND SALE OF FOOD PRODUCTS.

This law was passed in 1895. The Connecticut Agricultural Experiment Station, under whose control it is placed, has accomplished good results since its passage in sampling and analyzing many of the food products of the State. Their reports show the large amount of adulteration which is found in the different foods sampled, the kinds of adulterants, and the per cent. used.

These reports are sent to anyone whose name and address is sent to the Station.

The last Legislature amended this law, giving the Dairy Commissioner or his deputy power to take samples of all kinds of articles used for food, and when these samples, or samples taken by the Experiment Station have been found by analysis to be adulterated, the Experiment Station shall report the fact found, to the Dairy Commissioner, who shall make complaint to the proper prosecuting officer to the end that violaters of the law shall be prosecuted. Under section 8 of this law a dealer must sell or offer for sale the food product, knowing it to be adulterated, to be liable to the fine imposed by said section. This department has prepared the following blank to be filled out and sent to any dealer when it is found by the returns from the chemist that they are selling adulterated food. If after such notice they sell the same, prosecution will follow. Quite a number of samples have been taken but we have not yet had any prosecutions under this law.

State of Connecticut.

DAIRY COMMISSIONER'S OFFICE.

J. B. NOBLE,
Commissioner.

R. O. EATON,
Deputy Commissioner.

HARTFORD,.....1900

To.....

Dear Sir:

You are hereby notified that the sample of.....labelled ....and sold for .....purchased at your place of business by..... ..... on..... 19...., in accordance with Chapter 22 of the Public Acts of 1899, is found by analysis to be adulterated.

Yours respectfully,

.....

Dairy Commissioner.

The law and amendment is here given:

AN ACT REGULATING THE MANUFACTURE AND SALE OF FOOD PRODUCTS.

SECTION 1. It shall be unlawful for any person, persons, or corporation within this State to manufacture for sale, offer, or expose for sale, have in his or their possession for sale, or to sell, any article of food which is adulterated or misbranded within the meaning of this act.

SEC. 2. The term food, as used in this act, shall include every article used for food or drink by man, horses, or cattle. The term misbranded, as used in this act, shall include every article of food and every article which enters into the composition of food, the package or label of which shall bear any statement purporting to name any ingredient or substance as not being contained in such article, which statement shall be untrue in any particular; or any statement purporting to name the substance or substances of which such article is made, which statement shall not give fully the names of all substances contained in such article in any measurable quantity.

SEC. 3. For the purposes of this act, an article shall be deemed adulterated: First, if any substance or substances be mixed or packed with it so as to reduce or lower or injuriously affect its quality or strength; second, if any inferior substance or substances be substituted wholly or in part for the article; third, if any valuable constituent of the article has been wholly or in part abstracted; fourth, if it be an imitation of or sold under the name of another article; fifth, if it is colored, coated, polished, or powdered whereby damage is concealed, or if it is made to appear better or of greater value than it is; sixth, if it contains poisonous ingredients which may render such article injurious to the health of a party consuming it, or if it contain any antiseptic or preservative not evident and not known to the purchaser or consumer; seventh, if it consists in whole or in part, of a diseased, filthy, decomposed, or putrid substance, either animal or vegetable, unfit for food, whether manufactured or not, or if it is in any part the product of a diseased animal, or of any animal that has died otherwise than by slaughter; *provided*, that an article of food product shall not be deemed adulterated or misbranded within the meaning of this act in the following cases: (*a*) In the case of mixtures or compounds which may be now or from time to time hereafter known as articles of food under their own distinctive names, and not included in definition fourth of this section; (*b*) in the case of articles labelled, branded, or tagged, so as plainly and correctly to show that they are mixtures, compounds, combinations, or blends; (*c*) when any matter or ingredient is added to a food because the same is required for the protection or preparation thereof as an article of commerce in a fit state for carriage or consumption, and not fraudulently to increase the bulk, weight, or measure of the food or

to conceal the inferior quality thereof; (*d*) when a food is unavoidably mixed with some extraneous matter in the process of collection or preparation.

SEC. 4. The Connecticut Agricultural Experiment Station shall make analyses of food products on sale in Connecticut, suspected of being adulterated, at such times and places and to such an extent as it may determine, and may appoint such agent or agents as it deems necessary; who shall have free access, at all reasonable hours, for the purpose of examining into any place wherein it is suspected any article of food adulterated with any deleterious or foreign ingredient or ingredients exists, and such agent or agents upon tendering the market price of said article, may take from any person, firm, or corporation samples of any article suspected of being adulterated as aforesaid, and the said station may adopt or fix standards of purity, quality, or strength, when such standards are not specified or fixed by statute.

SEC. 5. Whenever said station shall find by its analysis that adulterated food products have been on sale in the State, it shall forthwith transmit the facts so found to a grand juror or prosecuting attorney of the town in which said adulterated food product was found.

SEC. 6. The said station shall make an annual report to the Governor upon adulterated food products, in addition to the reports required by law, which shall not exceed one hundred and fifty pages, and said report may be included in the report which said station is already authorized by law to make, and such annual reports shall be submitted to the General Assembly at its regular session.

SEC. 7. To carry out the provisions of this act, the additional sum of twenty-five hundred dollars is hereby annually appropriated to said Connecticut Agricultural Experiment Station, which sum shall be paid in equal quarterly installments to the treasurer of the board of control of said station, upon the order of the comptroller, who is hereby directed to draw his order for the same.

SEC. 8. Any person who, either by himself, his agent, or attorney, with the intent that the same may be sold as undulterated, adulterates any food products for man, or horses, or cattle, or, knowing that the same has been adulterated, offers for sale, or sells the same as unadultered, or without disclosing or informing the purchaser that the same has been adulterated, shall be fined not more than five hundred dollars, or imprisoned not more than one year.

SEC. 9. No action shall be maintained in any court in this State on account of any sale or other contract made in violation of this act.

SEC. 10. All acts and parts of acts inconsistent herewith are hereby repealed.

Approved, June 26, 1895.

AN ACT AMENDING AN ACT REGULATING THE MANUFACTURE AND SALE OF FOOD PRODUCTS.

SECTION 1. Sections four and five of Chapter ccxxxv. of the Public Acts of 1895 are hereby amended to read as follows:

SEC. 4. The Connecticut Agricultural Experiment Station shall make analyses of food products on sale in Connecticut, or kept in Connecticut for export, to be sold without the State, suspected of being adulterated. Samples of food products for analysis shall be taken by the duly authorized agents of the Station, or by the Dairy Commissioner or his deputy, at such times and places and to such an extent as in the judgment of the officers of said Experiment Station and of the Dairy Commissioner shall seem expedient. The Dairy Commissioner or his deputy shall have full access at all reasonable hours to any place wherein it is suspected that there is kept for sale or for export, as above specified, any article of food adulterated with any deleterious or foreign ingredient or ingredients, and said Dairy Commissioner or his deputy, upon tendering the market price of such article, may take from any person, firm, or corporation, samples of the same. The said Experiment Station may adopt or fix standards of purity, quality, or strength, when such standards are not specified by law.

SEC. 5. Whenever said Experiment Station shall find by its analysis that adulterated food products have been on sale in the State, or kept in the State for export, for sale without the State, it shall forthwith transmit the facts so found to the Dairy Commissioner, who shall make complaint to the proper prosecuting officer, to the end that violators of the law relating to the adulteration of food products shall be prosecuted.

SEC. 2. This act shall take effect from its passage.

Approved March 23, 1899.

AN ACT CONCERNING THE REGULATION OF THE SALE OF CONCENTRATED COMMERCIAL FEEDING STUFFS.

This law was passed at the last session of the Legislature and is very similar in all its requirements to the law passed in the State of Rhode Island. Quite a number of other States have passed laws upon the same subject. It has lately been found that large quantities of low-grade feeding stuffs have been put upon the market here in our State, and some of it has evidently been selling for a good deal more than its feeding value as shown by analysis. This law makes it obligatory for all persons selling or offering for sale within the State any concentrated

feeding stuffs to have a plain printed statement affixed thereto, giving the manufacturer's name and address with trade mark, if any, the number of net pounds in bag, and the analysis showing the per cent. of protein and crude fat. This is a good law and will work for the good of all consumers of feeding stuffs, as it gives each one an opportunity to know just the commercial value of the feed he is purchasing. All dealers who wish to sell pure, high-grade feed are in perfect sympathy with it, and are ready to comply with its requirements. As this is a new law and came into effect just when many dealers had a large stock of goods on hand which they had bought for the winter trade it would have been quite a loss to them to have all those goods analyzed before offering for sale. Some time has been allowed for a full compliance to the law, as these brands and analyses should be given by the manufacturers. Many of these have signified their willingness to comply with the law. This department, in connection with the officers of the Agricultural Experiment Station, is earnestly endeavoring to carry out the provisions of this law, and in the near future expect to see all dealers fully complying with its requirements. Soon after this became a law the following circular letter was sent to all millers and dealers in the State, together with a copy of the law, so that all may know the requirements and what was necessary to be done to comply with it. The many answers received from dealers in the State express their desire and willingness to comply with all its provisions. The only exceptions noted was along the line of standard brans and mixed feeds. Some were of the opinion that it would take some little time to fully comply with it in regard to these feeds, as they were sold in large quantities by manufacturers from out of the State, and many times the manufacturers did not know when they were sent from the mill just what their destination would be, as there are large quantities in transit. But the justice of having these feeds included is shown by the fact recently brought to notice that there are large concerns in the West whose only business is to grind a mixture of bran and corn cobs. The law is here given.

State of Connecticut.

DAIRY COMMISSIONER'S OFFICE.

J. B. NOBLE,
Commissioner.

R. O. EATON,
Deputy Commissioner.

HARTFORD,.....

To.....

Dear Sir:

Your attention is respectfully called to the enclosed Public Act passed at the January Session, 1899, of the Legislature, regulating the sale of Concentrated Feeding Stuffs, and that the law makes it the duty of the Dairy Commissioner to attend to the enforcement of the same.

You will please note the requirements of the law and kindly see that the same are complied with, and thus avoid the penalty given in Section 5 of this law.

Dealers sending you goods from out of the State can furnish you with data upon which you can base your statements.

J. B. NOBLE,
Dairy Commissioner.

AN ACT CONCERNING THE REGULATION OF THE SALE OF CONCENTRATED COMMERCIAL FEEDING STUFFS.

SECTION 1. Every lot or parcel of concentrated commercial feeding stuff, as defined in section three of this act, used for feeding domestic animals, sold, offered or exposed for sale within this State, shall have affixed thereto in a conspicuous place on the outside thereof, a legible and plainly printed statement, clearly and truly certifying the number of net pounds of feeding stuff contained therein, the name, brand, or trade mark under which the article is sold, the name and address of the manufacturer or importer, and a statement of the percentage it contains of crude fat and of crude protein, allowing one per cent. of nitrogen to equal six and one-fourth per cent. of protein, both constituents to be determined by the methods adopted at the time by the Association of Official Agricultural Chemists of the United States.

SEC. 2. The term concentrated commercial feeding stuff as herein used, shall not include hays and straws, the whole seeds nor the unmixed meals made directly from the seed of wheat, rye, barley, oats, Indian corn, buckwheat, or broom corn.

SEC. 3. The term concentrated commercial feeding stuff as herein used shall include linseed meals, cottonseed meals, pea meals, cocoanut meals, gluten meals, gluten feeds, maize feeds, starch feeds, sugar feeds, dried brewers' grains, malt sprouts, hominy feeds, cerealine feeds, rice meals, oat feeds, corn and oat chop, corn and oat feeds, ground beef, or fish scraps, mixed feeds, provenders bran, middlings, and mixed feeds made wholly or in part from wheat, rye, or buckwheat, and all materials of a similar nature not included in section two of this act.

SEC. 4. Each and every manufacturer, importer, agent, or seller of any concentrated commercial feeding stuff shall, upon request, file with the Connecticut Agricultural Experiment Station a certified copy of the statement named in section one of this act.

SEC. 5. Each and every manufacturer, importer, agent, or person selling, offering, or exposing for sale in this State any concentrated commercial feeding stuff, as defined in section three of this act without the statement required by section one of this act, and stating that said feeding stuff contains substantially a larger percentage of either of the constituents mentioned in section one, than is contained therein, or in relation to which the provisions of all of the foregoing sections have not been fully complied with, shall be fined not exceeding one hundred dollars for the first offense and not exceeding two hundred dollars for each subsequent offense.

SEC. 6. The Connecticut Agricultural Experiment Station is hereby authorized to have collected a sample not exceeding two pounds in weight, for analysis from any lot, parcel, or package of concentrated commercial feeding stuff as defined by section three of

this act, or unmixed meals, brans, or middlings named in section two of this act, which may be in the possession of any manufacturer, importer, agent, or dealer, but said sample shall be taken in the presence of said party or parties in interest or their representatives, and taken from a number of parcels or packages which shall be not less than 5 per cent. of the whole lot inspected, and shall be thoroughly mixed, divided into two samples, placed in glass vessels, carefully sealed, and a label placed on each stating the name or brand of the feeding stuff or material sampled, the name of the party from whose stock the sample was taken, and the time and place of taking the same, and said label shall be signed by said chemist or his deputy, and by the party or parties in interest or their representatives present at the taking and sealing of said sample; one of said samples shall be retained by said chemist or his deputy, and the other by the party whose stock is sampled. Said Connecticut Agricultural Experiment Station shall cause at least one sample of each brand of feeding stuff collected as herein provided to be analyzed annually by or under the direction of said chemist. Said analysis shall include determinations of crude fat and crude protein and such other determinations as may at any time be deemed advisable. Said Connecticut Agricultural Experiment Station shall cause the analysis so made to be published in station bulletins, together with such other additional information in relation to the character, composition, and use thereof as may seem to be of importance, and issue the same annually, or more frequently if deemed advisable.

SEC. 7. It shall be the duty of the Dairy Commissioner to attend to the enforcement of this act, and, when any evidence is submitted by the Connecticut Agricultural Experiment Station that the provisions of this act have been violated, he shall make complaint to the proper prosecuting officer, to the end that the violator may be prosecuted.

SEC. 8. The term importer for all the purposes of this act is intended to apply to such person or persons as shall bring into or offer for sale within this State, concentrated commercial feeding stuffs manufactured without this State.

SEC. 9. This bill shall not apply to feed ground from whole grain and sold directly from manufacturer to consumer.

SEC. 10. All acts or parts of acts inconsistent herewith are hereby repealed.

SEC. 11. This act shall take effect on and after July 1st, 1899.

Approved June 20, 1899.

ADDRESS BY THE HON. LEVI WELLS,

President of the National Association of State Dairy and Food Departments.

Mr. Wells is State Dairy Commissioner of Pennsylvania, and delivered this address upon fraud in food products in Chicago at the last meeting of the Association :

FRAUD IN FOOD PRODUCTS.

An appreciative audience is always desirable, but when an audience knows more of the subject to be discussed than does the speaker, it is liable to become embarrassing to both speaker and audience. This outlines, in a measure, present conditions. However, I shall not be deterred from throwing out a few suggestions regarding many frauds which are perpetrated in handling food products, and also dwelling somewhat on various food adulterations, hoping in so doing to open a discussion that may be profitable and interesting to members of this Association who have these subjects to deal with.

Many frauds are not adulterations. Often in commercial transactions in food products quantity and not quality contains the nut of the cocoanut in the hidden fraud. For instance, five-fourths are made from one whole, and with these gentlemen who practice their deceptive arts on an unsuspecting public, fundamental rules of mathematics, such as four quarters making one whole, are set aside. To illustrate : the retail dealer buys of the city jobber, we will say, ten or twenty barrels of salt mackerel, so much for No. 1's, a lesser price for No. 2's and a still smaller price for No. 3's, each barrel containing 200 honest pounds of 16 ounces each. The grocer may then be asked how he will have these goods put up. He replies, I will have them in kits, as my trade is largely in a farming community, and farmers like to buy these quarter-barrel kits. Will you have them put up in fours or fives ? Oh, in fives, of course, computing in his mind how much more money he will get from five quarters of one whole than he will from four. The chances are the grocer has bought No. 2 grade, but as it is just as easy to have them branded No. 1 he does so and the good farmer and his wife wonder why it is since the Spanish War that No. 1 mackerel are not as large and fine as they used to be.

Soda, baking powder and other package goods may be put up in one hundred packages to the hundred weight, or there may be one hundred and twenty-five packages from the same amount, according to the wishes of the dealer; and then, too, if he is a one hundred and twenty-five man the manufacturer or jobber is more than willing to put the dealer's name on the package in place of his own, or he may say "put up expressly for so and so." It is always safe to look out for goods with a dealer's name on the package.

There is, perhaps, no one article of food that there has been more deception practiced in than that of baking powder, nor one by which the people have been fleeced out of more money, and it has been done in a very peculiar way. The use of leaven comes down to us from time immemorial and we read of "a little leaven leavening the whole lump," but with baking powder men a great deal of lying brings in the shekels. The ideal leavening agent is yeast, which generates carbonic acid gas at the expense of the carbohydrates already existing in the flour without introducing any foreign element; but this process of leavening is slow, and resort to the use of a chemical aerating agent arose from this fact, so that every housewife provided herself with saleratus and cream of tartar. Not many years ago some ingenious person thought it would be a good idea to mix acid and soda and put them up in packages ready for use, the result being what is now known as baking powder. The convenience of having them prepared in this way has created a popular demand for them, and there are at present in the United States probably twelve million families making a daily use of baking powder. This immense demand stimulated the industry, and resulted in a great amount of deception being practiced in compounding and advertising these goods. The varions brands differ, as is well known, only in the kind of acid used in their preparation. I am not here to advocate the use of any particular kind of powder, but I would like to disabuse the public in the belief that only certain kinds can safely be used. I would also like to explode the fallacy that any powder is perfectly pure, for they are all somewhat objectionable, not from the fact that the ingredients themselves are harmful in any particular way, but after the carbonic acid gas is generated and the results are obtained for which powders are used, there is left in the food a resultant salt that is objectionable as a food product, whether it

be Rochelle salts, as is the case in cream of tartar powders, or whether it be something else, the result of an alum or an alum phosphate powder. Through skillful advertising and a vast amount of deceptive literature circulated through the press, the cream of tartar powder people have led the people to believe that only those powders are safe to use. The price to consumers of these powders is from forty-five to fifty cents. The amount of powders consumed in the United States is from sixty to one hundred million pounds a year, and the profit to these people, if they had the entire trade of the country, would not be less than twenty million dollars annually. This business is controlled by a trust capitalized at twenty millions of dollars.

If the composition of baking powders was wholly volatile, and the entire substance could be converted into carbonic acid gas, this would constitute a perfect baking powder. The aeration, or lightening of the material to be baked would be performed and nothing objectionable would remain in the food. Desirable as such a combination would be, none has ever yet been discovered. The nearest approach to it was one made by a college professor, consisting of a soda solution and a solution of muriatic acid of such strength that an equal volume of one would neutralize an equal volume of the other, the reaction being common salt water and carbonic acid, the residue in this case being salt, which is beneficial. The prejudice against the use of muriatic acid as a food product prevented its use.

I recently directed one of our chemists to procure a sample of each of the three kinds of baking powders on our market. For the cream of tartar powder he paid fifty cents a pound, twenty cents a pound for the alum phosphate and five cents for a pound of alum powder. He reported fourteen cents as the cost of the material of which the cream of tartar powder was composed, and about three cents for the alum powder, and a small fraction more for the alum phosphate. The amount of residue remaining in the food from the cream of tartar powder was 81 per cent. of the original mixture, being Rochelle salts. The percentage of residue of an alum powder is a trifle less, consisting of Glauber salts and a small amount of aluminium, the latter being insoluble in water. The residue from the sample of alum phosphate was from two teaspoonsful, the quantity directed to be used in a quart of flour, twenty-nine grains of sulphate of aluminium, sixteen grains of sulphate of lime, sixteen grains of sulphate of

amonium and fifty-six of crystallized sulphate of soda, the total amounting to about 35 per cent. of the original powder, smaller by more than one-half than that of either of the other powders.

Which is the least harmful of these various preparations I am not prepared to say, but I do not hesitate to express my belief that, so far as healthfulness is concerned, the cheaper alum and alum phosphate powders are no more objectionable than are the cream of tartar powders.

RENOVATED BUTTER.

One of the great frauds practiced has been the sale throughout the country of large quantities of renovated or made-over butter, and to complete the deception it is generally sold under some deceptive name such as "Iowa Star Creamery, guaranteed pure, etc."*

A fraud of equal or greater magnitude than that of renovated butter is that of selling oleomargarine for butter. To stamp out the sale of oleomargarine entirely is, in my opinion, impossible, especially so after the United States Supreme Court in an opinion handed down in May, 1898, pronounced it a legitimate article of commerce, both foreign and domestic, and that as such it had its legitimate rights under the inter-state commerce law. The Pennsylvania prohibitory law, in so far as it was brought before that court, was pronounced unconstitutional, and now we have another there governing the sale under a license system with sufficient safe guards thrown around to prevent its being sold for butter. This law, in a measure at least, places it on the same broad principle which should, in my estimation, govern all food legislation, viz.: that any article of food not detrimental to health may be sold for what it is. This is fair to the producer and to the consumer; it is simply an honest square deal all around, but the great trouble has been and is now with these oleomargarine people, that they are not willing to sell it for what it is, and I think the principle reason for this is that there is very little demand for oleomargarine and, hence, to sell it to any great extent they are obliged to palm it off as butter. Against this fraud both dairymen and consumers have a right to object, and public opinion and the courts everywhere will sustain them in it,

*A description of process butter and the methods used in its manufacture, as given by Mr. Wells, will be found under the head of "Process Butter" in this report, on page 46.

because it is right. I think one trouble with the dairymen has been, regarding this question, in asking and expecting too much. They are not willing oleomargarine should exist. They want to wholly prevent its manufacture and use, which is an impossibility when the United States Supreme Court says it is a legitimate article of commerce.

I think in Pennsylvania we have a very good law governing the sale of oleomargarine. I believe that under it we can and are compelling them to sell it for what it is. I believe that when so sold the demand for it is not sufficient to seriously effect the sale of good butter. Oleomargarine does not and cannot come in competition with high-grade butter or seriously affect its price; it only comes in competition with inferior and low-grade butter. If all butter was of the high grade and quality that it should and could be, it would have its own wide field to be disposed of in at a remunerative price, and oleomargarine would have its own narrow field where it would be disposed of at a lesser price, neither interfering the one with the other.

Let us as dairymen be reasonable and just, attacking and mastering all problems that can result in advantage to our business, and leave to the fanatic the visionary schemes that have been too common and that are still being pressed upon our attention through solicitations for contributions through interested parties.

A new fraud was recently brought to my attention in condensed milk.

Instead of being made from pure milk, skim milk is used, and in place of the cream taken from the milk foreign fats are substituted, consisting of oleo and neutral fats derived from tallow and lard. It is very unfortunate that such a fraud should be introduced just as the condensed milk business is assuming such large proportions and was just becoming a very important dairy industry.

A very common fraud, and one that fleeces consumers out of a very large amount of money is that of watering milk.

Some years ago in a city of Pennsylvania, having a population of about 60,000, where there was no milk supervision, I took the matter in hand under the pure food law. Samples were secured and analyzed, and about one-fourth of them were found to be adulterated, a few containing as high as twenty per cent. of added water. A careful computation was made, and, assuming that the same ratio of adulteration extended to all the milk con-

sumed in the city, it was found that its citizens were paying about $21,000 annually for water added to their milk, at six cents per quart, this being the price at which it was sold.

The subject of meat preservatives and embalmed meat has been thoroughly agitated in this country during the past year. I have here a few samples of chemicals, coloring materials, etc., which are extensively sold to butchers throughout the country, and used principally to preserve and rejuvinate cut meats. The most of these samples both preserve and color; or, if you perefer a more expressive word, embalm and color. By use of the chemicals and coloring matter butchers, when meat begins to get stale and turn dark colored, can with this boracic acid and other materials preserve it for all time to come, and the coal tar dye with which it is mixed imparts a beautiful red tint to it, and one would little suspect from its appearance that it had been hanging around for weeks, now that it looks so fresh and tempting. Here also is a sample of brown coal tar dye used for outside coloring. If you will observe closely you will notice that your hams, bacon, etc., that seem so nicely smoked have no smell of that article. No hickory wood or corn cobs were ever consumed in smoking these goods. A solution of this dye gives the proper amber tint. Simply a dip of the ham in the liquid, and, presto, the ham is smoked. No loss in weight by drying out and next to no expense. If the dye is a poison it is not expected to kill any one, as it will likely be trimmed off before being consumed. I have here some of the manufactured article that I bought nearly a year ago at a railroad eating house in Sunbury, Penn. It has dried out some, but otherwise it is in a perfect state of preservation and will keep as long as the mummies of Egypt. There has been a great deal written and said about chemically preserved meats. We had several prosecutions in Pittsburg, and convictions were obtained in all cases brought. The goods were put up principally in Chicago and bought and sold by retailers in our State. Boracic acid was the preservative, and the expert evidence given at the trial by physicians and scientists, who had made the matter a study, was, that it was an unfit article of food.

VINEGAR.

Previous to three years ago probably seventy-five per cent. of the vinegar sold as cider vinegar in Pennsylvania was a colored distilled vinegar that cost less than four cents a gallon to

manufacture. All colored distilled vinegar in the State was being sold for cider vinegar at cider vinegar prices. I suppose today the same conditions prevail in many States as did there at that time. It was only by a determined and vigorous crusade carried on against this fraud in Pennsylvania that its sale under a false name was broken up. As this vinegar carried comparatively no solids, it was very easily detected and thousands of barrels have been shipped back by the retail grocers of the State to parties of whom they procured it. This vinegar, like oleomargarine, when sold for what it was not, yielded large profits to those who handled it, and for this reason a determined effort was made to deceive the chemists by adding to the distilled vinegar apple solids sufficient to comply with the act in that State governing the sale of vinegars. In this way the contest was somewhat prolonged until more exhaustive methods of analysis were resorted to by our chemists, and the fraud was detected by other means than that of determining the solids, the result of which has been to force dealers to sell their vinegar for what it is.

We also had a clause inserted in the last vinegar act prohibiting the coloring of distilled vinegar. At present vinegars of Pennsylvania are sold true to name, and doctored vinegars are seldom found in our markets there. I think the work carried on there in this line has been one of the most important of any in the department. The price now of distilled vinegar is greatly reduced, and that of cider vinegar has been increased until it has become an important factor in the disposal of the apple product of the State, and farmers and horticulturists are reaping the benefit resulting from this work, and consumers who want cider vinegar are getting it.

Another fraud that was extensively practiced on consumers before pure food laws were enforced was substituting cheaper and inferior articles and selling the same as genuine. Among the more common deceptions, I mention sulphate of lime for cream-of-tartar, cotton seed oil for olive oil, various cereals burned and ground and sold for coffee, ether extracts to imitate various fruit flavors, glucose for cane syrup and molasses, cane syrups and glucose for maple syrups, jams, jellies, etc., made from gelatine, starch and glucose flavored to represent various kinds of fruits and sold as such. A grade better than this is jellies, jams, etc., made from apple cider, flavored and colored

artificially to represent plums, peaches, cherries, currants and different berries. Haddock sold as codfish, mince meat without any meat, and horse flesh for beef. Closely allied to these substitutions are the fraudulent admixtures of worthless articles, such as gypsum, sand, white earth, buckwheat hulls, cocoanut and almond shells, etc., in spices and condiments.

This convention is composed largely of persons whose duty it is to enforce the laws governing the sale of food products, and while I believe we should at all times be reasonable and very careful not to impose unnecessary hardships on the trade of our various states, yet I believe, that when we are fortified with just and reasonable laws that we should never retreat, but insist on a full compliance with the same.

No more honorable record was ever earned than that to which the United States Marines are entitled. They were never known to retreat, and that honorable record has never been broken, even at Guantanamo, Cuba, where they were besieged and under fire for three days and nights without support, and knowing that no aid would come.

Let us as Commissioners emulate this remarkable record, standing shoulder to shoulder, and keep up the good fight until fraud in food products shall only be known as a thing of the past.

EXPENSES

FOR THE YEAR ENDING SEPTEMBER 30, 1899.

Salary of Commissioner,	$1,500 00
Office and Travelling Expenses,	555 54
Salary of Deputy Commissioner,	1,200 00
Travelling Expenses of Deputy,	562 82

CONCLUSION.

The past year has been one of especial activity in all of the work pertaining to this department. Investigations have been made in all parts of the State to see that the provisions of our pure food laws are complied with. Stores in all cities and many country towns have been visited, and those articles on sale over which this department has charge have been examined, and many samples taken and preliminary tests made in the office. Also several hundred have been sent to the Experiment Station for more thorough and complete analysis, as prosecutions are made upon returns from chemists for adulteration or fraud. The high price which dairy butter has sustained through the year has caused unusual activity among the manufacturers of imitation butter in all parts of the country. The increase in the number of pounds manufactured has been quite large, and consequently the efforts to sell, equally strenuous. It has required constant watch in all parts of the State to see that the provisions of our oleomargarine law are not violated. Bakeries, boarding houses, restaurants, and hotels have been visited, and the butter used examined, and if at all suspicious has been tested. The wisdom shown in the passage of this law has been most clearly proved in that it has been of great benefit to the dairy interests of the State, and at the same time just to all consumers of creamery butter. Without such a law there would be hundreds of licensed dealers in the State, and consumers, in many cases, would be paying the price of creamery butter for a ten-cent imitation product. The tub butter law has in general proved a beneficial one, and the trade are conforming to its requirements. The

special law, prohibiting the sale of adulterated molasses, commends itself to all consumers and is satisfactory to all dealers who wish to sell only pure straight goods. The need of such a law is clearly shown by the examinations made, and the prosecutions we have had during the year. Without it very large amounts of cheap glucose and other adulterants would be sold in place of the pure molasses, and consumers would be deceived and defrauded. The law in relation to the manufacture and sale of vinegar is quite an important one in the State. All manufacturers of vinegar are interested to see that they do not have to compete with a cheap article made from acid and water, and consumers of pure cider vinegar do not wish to purchase or use something which is entirely different. We take satisfaction in stating that the sale of fraudulent acid vinegar is largely driven from the State, and good cider vinegar is taking its place. Quite an amount of work has been done under the new law relating to the sale of concentrated commercial feeding stuffs. The dairy interests of the State are deeply interested in this law, as well as all who purchase feeds. We believe this law will have the effect to soon drive all fraudulent feeds from our markets, and thus be directly helpful to all purchasers.

The general pure food law, which is in charge of the Connecticut Experiment Station, together with this department, is one of interest to all consumers in the State. Adulterations are carried on in many lines, and there are also frauds which can not strictly be classed under this head. Articles are sold under weight, and those of the same kind many times vary largely in quality. Some of them are a high grade and some practically worthless. We think the time will soon come when a standard will be asked for in many articles of trade; for instance, the range in quality in spices and many other articles is very great. The interest in pure food legislation throughout the country is increasing each year. At the National Association of State Dairy and Food Departments held in Chicago in September this was very manifest. Commissioners were present from a large number of States, all working toward the same end and striving to accomplish the same result: that of lessening fraud and adulterations in food and doing what they can to give the consumers of their several States the assurance that they are receiving just what they desire to purchase.

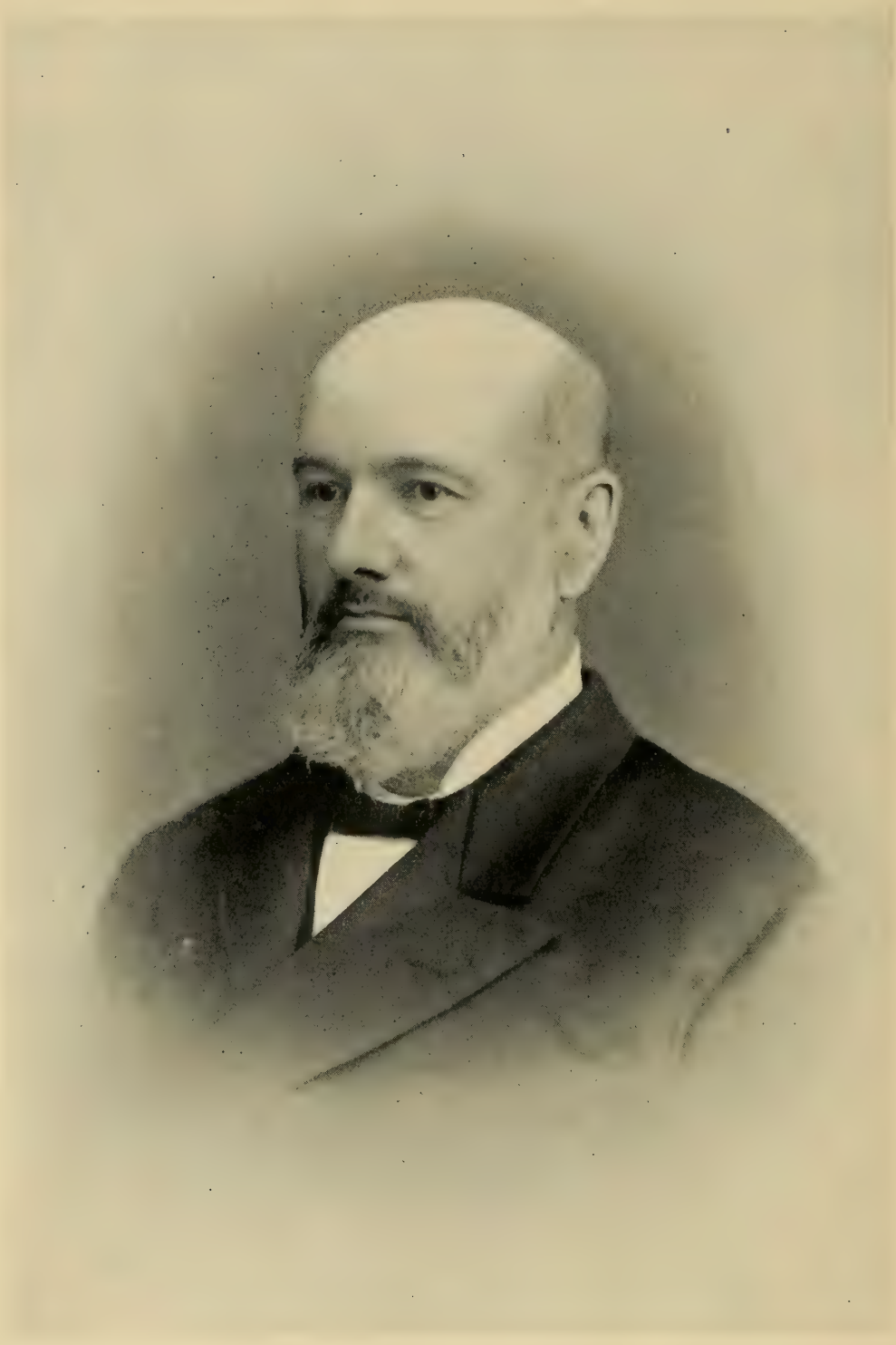
Connecticut has been foremost in her pure food legislation, and we have the satisfaction in knowing that since 1886, when the first oleomargarine law was passed, good results have been obtained.

I express sincere thanks to the officers of the Connecticut Agricultural Experiment Station for the co-operation and good will that has been shown to this department through the year, also to the many court officers of the State, the Dairymen's Association and Creamery Association for the help and assistance given, and for the hearty support of the people throughout the State.

Respectfully submitted,

JOHN B. NOBLE,

Dairy Commissioner.



JOHN T. ROCKWELL.

State of Connecticut

PUBLIC DOCUMENT

THIRTY-THIRD ANNUAL REPORT

OF THE

SECRETARY

OF THE

Connecticut Board of Agriculture

1899

PRINTED BY ORDER OF THE LEGISLATURE

HARTFORD, CONN.
The Case, Lockwood & Brainard Company
1900

To the Governor of the State of Connecticut:

In accordance with the provisions of the Act creating a State Board of Agriculture, I have the honor to present the Report for 1899.

T. S. GOLD, Secretary.

West Cornwall, December 1, 1899.

STATE BOARD OF AGRICULTURE.

1898–99.

His Excellency GEORGE E. LOUNSBURY, *ex officio.*

APPOINTED BY THE GOVERNOR.

		Term Expires.
Charles L. Tuttle,	Hartford,	1901
James F. Brown,	North Stonington,	1901
Charles E. Chapman,	Westbrook,	1903
Iverson C. Fanton,	Westport,	1903

APPOINTED BY THE GENERAL ASSEMBLY.

Hartford County,	Edmund Halladay, Suffield,	1901
New Haven County,	Fred'k Doolittle, Cheshire,	1901
New London County,	E. Judson Miner, Bozrah,	1901
Fairfield County,	Seaman Mead, Greenwich,	1901
Windham County,	Nathaniel G. Williams, Brooklyn,	1903
Litchfield County,	Edwin G. Seeley, Roxbury,	1903
Middlesex County,	Edbert D. Hammond, Cromwell,	1903
Tolland County,	Chas. A. Thompson, Melrose,	1903

OFFICIAL LIST.

Governor GEORGE E. LOUNSBURY, *President.*

Edwin G. Seeley,	Roxbury,	*Vice-President*
T. S. Gold,	West Cornwall,	*Secretary*
Chas. A. Thompson,	Melrose,	*Treasurer*
Prof. S. W. Johnson,	New Haven,	*Chemist*
Prof. B. F. Koons,	Storrs,	*Entomologist*
Dr. W. C. Sturgis,	New Haven,	*Botanist*
N. S. Platt,	New Haven,	*Pomologist*

Auditors.

Fred. Doolittle, Seaman Mead, E. Judson Miner.

REPORT.

AGRICULTURAL FAIRS IN CONNECTICUT, 1899.

With Visiting Delegates.

New London County, Sept. 4-6. E. Halladay.
Windham County, Sept. 19-21. J. F. Brown.
Beacon Valley, Sept. 19-20. Seaman Mead.
Berlin, Sept. 27. E. D. Hammond.
Branford, Sept. 20. F. Doolittle.
Bristol Fair Corp., Sept. 26-27. C. A. Thompson.
Chester, Sept. 27. N. G. Williams.
Clinton, Oct. 4. N. S. Platt.
Danbury, Oct. 2-7. S. Mead and C. E. Chapman.
Farmington Valley, Sept. 6-7. I. C. Fanton.
Granby, Sept. 27-28. C. L. Tuttle.
Guilford, Sept. 22.
Harwinton, Oct. 3. E. J. Miner.
Madison, Sept. 20. E. D. Hammond.
New Milford, Sept. 12-14. N. G. Williams, Brooklyn.
Newtown, Sept. 26-28. F. Doolittle.
Orange, Sept. 14.
Putnam Park and Fair Corpn., Sept. 22-24. C. A. Thompson.
Rockville Fair Asso., Sept. 19-21. C. L. Tuttle.
Simsbury, Sept. 19-20.
Southington, Sept. 19-20. E. G. Seeley.
Stafford Springs, Oct. 3-5. E. Halladay.
Suffield, Sept. 19-20. J. F. Brown.
Union (Monroe, etc.), Sept. 19-20. N. S. Platt.
Union (Somers, etc.), Sept. 27. E. G. Seeley.

Wethersfield Grange Corpn., Sept. 26-28. Charles C. Harris.
Willimantic, Fair Asso., Sept. 26-28. E. J. Miner.
Windsor, Sept. 13-14. C. L. Tuttle.
Woodstock, Sept. 4-6. C. E. Chapman.
Wolcott, Oct. 11. I. C. Fanton.
Connecticut Hort. Soc.,* Hartford. T. S. Gold.
Connecticut Dairy Asso., Hartford, Jan. 19-21.
Connecticut Pom. Socy., Meriden, Oct. 3-4. N. S. Platt and T. S. Gold.

FARMERS' INSTITUTES.

Institutes have been held on invitation in various parts of the State during the past year. The plan is explained in a Prospectus, issued by the Board in joint action with the two experiment stations in the State. Unfavorable weather sometimes interfered with attendance, otherwise it was good, and the Institutes were successful.

The plan seeks to cover the whole State, by two or more institutes in each county, and offers opportunities to places that are not so easily reached, and that have never had an Institute. The fact that most applications come from places that have had Institutes is the best testimony to the value of the work. Confident of the ability of the speakers offered to entertain, as well as instruct, an audience, we hope the rural communities will accept our offers, and that the interests of agriculture may be promoted by this effort in disseminating knowledge in agriculture and home life.

Institutes were held at Wapping, Dec. 6, 1898; Storrs College, Dec. 9, 1898; Southington, Dec. 16, 1898; Milford, Jan. 24, 1899; East Haddam, Feb. 7, 1899; Collinsville, Feb. 8, 1899; Waterbury, Feb. 9, 1899; Shelton, Feb. 15, 1899; Scotland, Feb. 16, 1899; West Cornwall, March 1, 1899; Prospect, March 23, 1899; Trumbull, March 28, 1899; North Woodstock, April 5, 1899.

* April —, June —, July —, Sept. 6, 7, Nov. 8-10.

PROSPECTUS.

Farmers' Institutes by the Connecticut State Board of Agriculture, in co-operation with the State and Storrs Experiment Stations, for 1899-1900.

A committee representing the State and Storrs Agricultural Experiment Stations, and the Committee on Institutes, from the State Board of Agriculture, have formulated the following plan of Farmers' Institutes for the winter. It is hoped that Granges, Farmers' Clubs, and individuals will take an interest in this work and make early applications and arrangements for an Institute, so that the committee may be able to furnish the selected speakers. It is the wish of the committee to distribute the work as uniformly over the State as possible.

The plan is to hold at least two or three Institutes in each county before April 1st.

Management of the Institutes to be in control of a joint committee, consisting of a Committee on Institutes, from the State Board of Agriculture, and one member appointed by each Station.

The Board pays for printing and traveling expenses. The service of the speakers is rendered without cost.

It is expected that places applying for Institutes will furnish a suitable hall, local transportation for speakers and visitors, music if desired, and entertainments by collation or otherwise, unless there are convenient hotel accommodations.

When application for Institutes is made, four speakers and subjects may be selected from the list, and two of them may be expected to meet the call, but each speaker has the privilege of sending a substitute in case of disability from illness or otherwise.

Applications for Institutes should be made to the Secretary at an early date, giving post-office, name of R. R. station, name of hall, and distance from R. R. station. Signify the day of the week preferred. The Secretary should have two weeks' notice to send to speakers.

Attention to these details will save much delay in correspondence. As good speakers are offered, the responsibility of securing a good attendance must rest with each locality. Local speakers, especially ladies, will be welcome at these Institutes. An exhibit of fruit and flowers is solicited.

The Question-box will be an important feature, allowing the introduction of any topic pertaining to agriculture.

A large choice of speakers and subjects is offered, but if we are obliged in some cases to send substitutes, we trust this will prove no disappointment. Some other speakers have been solicited, so that

some may be sent as substitutes who are not on the list. Please bear in mind that our number of lady speakers is limited, and they must be excused from answering calls if too numerous.

After a Grange or Farmers' Club or neighborhood has decided to apply for an Institute, a committee should be appointed with whom all of the local arrangements should rest. This committee should designate the place for holding the meeting, appoint one or two local speakers, provide music, arrange for transportation, collation, and otherwise enlist local interest.

LIST OF SPEAKERS AND SUBJECTS.

Connecticut Experiment Station.

Dr. E. H. Jenkins.

Farm Sanitation.
Sewage Disposal. Illustrated by Stereopticon.
Fermentation of Tobacco.
Cattle Feeding and Cattle Feeds now in the market.
Adulteration of Food Products.

Prof. W. E. Britton.

Planting to improve Rural Home Grounds with Native Trees and Shrubs.
Winter Gardening.
Our Insect Acquaintances. Illustrated by Stereopticon.

Dr. W. C. Sturgis.

Flowers and Fruit; a brief talk on Fertilization and Fruit Production.
Leaves and Fruit; the part which Foliage plays in Fruit Production.
Bacteria and their work, with special reference to Soil-bacteria.

Storrs Experiment Station.

Dr. W. O. Atwater.

The Farmer and his Food.

Prof. C. S. Phelps.

Feeds and Feeding of the Dairy Herd.
Fertilizers; Home mixed *vs.* Manufactured.
The Evolution of the Dairy Cow. Illustrated by Stereopticon.
Grass and other Forage Crops.

CONNECTICUT AGRICULTURAL COLLEGE.

Prof. A. G. GULLEY.

Arranging and Planting Home Grounds.
The Latest, Concerning Spraying.
The College. What it is Doing.

Prof. A. B. PEEBLES.

Climatology.
Twentieth Century Agriculture.
The Farmer's Environment.

Prof. L. P. CHAMBERLAIN.

The Rock Problem.
Agriculture as an Art.

Prof. N. S. MAYO.

Some Diseases of the Dairy Cow.
Wounds, and their Treatment.
Soundness in Horses.
Germs and Germ Diseases of Animals.
The Kansas Cowboy.
The Farmer of the Future.

Mrs. MAUDE K. WHEELER, Professor of Domestic Science.

The Chemistry of Foods.
Hygiene and Rural Sanitation.
The Housewife's Invisible Enemies.
Feeding of Children and Youth.

Prof. HENRY A. BALLOU.

The Gypsy Moth; what it is, and what it does.
Insects Affecting Apples.

Mr. C. L. BEACH, Dairy Instructor.

How to Select a Dairy Cow.
How to Feed a Dairy Cow.
How to make Dairying more Profitable.

Mr. H. S. PATTERSON, Instructor in Wood and Iron Shop.

The Relation of the Mechanic Arts to Agriculture.
The Origin and Development of the Arts and Sciences, particularly as applied to Architecture and Sculpture. Illustrated.

F. H. STADTMUELLER, Elmwood.

The Cost of Production.
Rural Economies.

E. C. Birge, Southport.

Intensive Dairy Farming.
Home Manufacture of Farm Machinery.
The New England Farmer's Manure Heap.

H. G. Manchester, West Winsted.

Good Potatoes, and How to Grow Them.
The Value of an Eye in Farming.
Business Farming, or Right and Wrong Ways of Buying and Selling.

George H. Merwin, Greenfield Hill.

A Dairy Farm, and How to Care for it.
Care and Management of Young Cattle.

Theo. A. Stanley, New Britain.

Tile Draining. Does it pay?
An Important Element on the Farm; the Hired Help.
The Use and Care of Tools on the Farm.

The Audubon Society of Connecticut, through their President, Mrs. Mabel C. Wright, of Fairfield, offers three lectures on Birds, fully illustrated by stereopticon. Early application, though desirable in all cases, is most important for all the illustrated lectures, as the slides may be engaged.

These lectures will be read, with the stereopticon to illustrate.

1. Facts about Birds that concern the Farmer.

Birds that protect the crops; also an account of the game birds to be seen in Connecticut during the year. Finely illustrated by pictures of birds of prey, insect-eating song birds, shore birds, and water fowls.

2. The Birds about Home.

An account of some familiar Connecticut birds, telling of their migrations, nesting habits, feeding methods, economic value, etc., and giving reasons, based upon sense, as well as sentiment, why they should be protected. Fully illustrated. (Suitable for mixed audiences of old or young people.)

3. The Adventures of a Robin.

A short story-lecture for children under ten, illustrated by twenty-five colored slides.

N. B. Please send in all applications early, that there may be ample time for arranging and advertising. It is understood that individual lecturers, as well as the committee, hold the privilege of substitution when necessary.

COMMITTEE ON FARMERS' INSTITUTES.

CONNECTICUT BOARD OF AGRICULTURE.

T. S. GOLD, Secretary, West Cornwall.

CHARLES L. TUTTLE, Hartford.
FREDERICK DOOLITTLE, Cheshire.
JAMES F. BROWN, North Stonington.
I. C. FANTON, Westport.
N. G. WILLIAMS, Brooklyn.
E. G. SEELEY, Roxbury.
E. D. HAMMOND, Cromwell.
C. A. THOMPSON, Melrose.

CONNECTICUT EXPERIMENT STATION.

Dr. E. H. JENKINS, Vice-Director, New Haven.

STORRS EXPERIMENT STATION.

Prof. C. S. PHELPS, Vice-Director, Storrs.

FARMERS' CONVENTION AT MERIDEN.

The annual Farmers' Convention was held at Meriden, Dec. 13, 14, and 15, according to the following programme.

It is the design of these meetings to present from year to year the progress of agriculture, by lectures and free discussion, so that Connecticut agriculture may truly be called progressive agriculture. Allied branches of science and knowledge are brought in review to broaden the range of thought, that the farmer and his family may have not only that knowledge of nature and its powers, which pertain to agriculture, but that knowledge of the wide world which makes the intelligent citizen, so that when called from the plow to fill positions of trust in war or peace, he may serve his country and honor his calling by his moral and mental, as well as physical powers.

The attendance at all the sessions was fair, but not quite equal to what might be expected from the reputation of the speakers.

The Secretary, in presenting this report, is sure it does not contain a dull page, except it may be some of his own work, and invites its careful perusal by all intelligent citizens. The show of fruit, corn, etc., was not large, but creditable. Both experiment stations made instructive exhibits of their work.

The Connecticut Agricultural College presented samples of work in wood and iron, neatly done by the students. The collections of plants made by the class in botany were beautifully preserved and much admired. We are pleased to notice an increasing study of this useful and charming branch of natural history, and hope that the time is not far distant when it will be taught in every school in the State.

FARMERS' CONVENTION. — Programme of the meeting of the Connecticut Board of Agriculture, at Meriden, December 13, 14, and 15, 1899.

Board of Agriculture. — (Organized 1866. Re-organized 1897.) Governor George E. Lounsbury, President; Edwin G. Seeley, Roxbury, Vice-President; T. S. Gold, West Cornwall, Secretary; Charles A. Thompson, Melrose, Treasurer; Prof. S. W. Johnson, New Haven, Chemist; Dr. E. H. Jenkins, New Haven, Botanist; Prof. B. F. Koons, Storrs, Entomologist; N. S. Platt, Cheshire, Pomologist; Fred. Doolittle, Seaman Mead, E. Judson Miner, Auditors.

Members: Governor George E. Lounsbury, *ex officio.*

Members appointed by the Governor and Senate: Charles L. Tuttle, Hartford, Hartford Co.; James F. Brown, North Stonington, New London Co.; Chas. E. Chapman, Westbrook, Middlesex Co.; Iverson C. Fanton, Westport, Fairfield Co.

Members appointed by the General Assembly: Edmund Halladay, Suffield, Hartford Co.; Frederick Doolittle, Cheshire, New Haven Co.; E. Judson Miner, Bozrah, New London Co.; Seaman Mead, Greenwich, Fairfield Co.; Daniel G. Williams, Brooklyn, Windham Co.; Edwin G. Seeley, Roxbury, Litchfield Co.; Edbert D. Hammond, Cromwell, Middlesex Co.; Charles A. Thompson, Melrose, Tolland Co.

WEDNESDAY, DECEMBER 13.

10.30 A. M. PRAYER.
ADDRESS OF WELCOME, by the Mayor, Hon. Amos Ives.
INTRODUCTORY ADDRESS, by His Excellency George E. Lounsbury.

11.30 A. M. LECTURE — Evolution in Farming. The Old and the New, Prof. W. H. Brewer, New Haven.

2.00 P. M. LECTURE—Some Facts and Fancies, Old or New, in Horticulture, Prof. L. H. Bailey, Ithaca, N. Y.

8.00 P. M. LECTURE — The Value of Birds to the Commonwealth. Illustrated by Specimens and by Stereopticon, Mr. Frank M. Chapman, American Museum National History, New York.

THURSDAY, DECEMBER 14.

10.00 A. M. LECTURE — The Sea, Hon. Henry P. Hedges, Bridgehampton, Suffolk County, N. Y.

2.00 P. M. LECTURE — The Farmer as a Citizen and in Social Life, Col. James Wood, Mt. Kisco, N. Y.

7.30 P. M. Question-box.

8.00 P. M. LECTURE — The English Language and Literature, Prof. R. W. Stimson, Storrs.

FRIDAY, DECEMBER 15.

10.00 A. M. The Connecticut Experiment Station. Summary of Work by Members of the Station Staff.

2.00 P. M. The Storrs Experiment Station and Connecticut Agricultural College. Summary of Work by Station Staff and Faculty of the College.

7.30 P. M. The Farm Garden, R. S. Hinman, Stevenson.

8.00 P. M. FLOWERS — Old and New, for the Home and for Market, Mrs. Nellis H. Sherwood, Southport.

After each lecture there will be an opportunity for questions and discussion; all interested are invited to be present, and engage in the discussions. The ladies are especially invited.

Music at intervals under the charge of Prof. A. B. Peebles.

A Question-box will be provided to receive questions upon any agricultural topic to be presented to the Convention for answer or discussion at convenient intervals. Get the questions in early.

The Convention will meet in the Meriden City Hall.

An exhibition of Fruits, Grains, Nuts, and other Farm Products, will be held under the charge of Mr. N. S. Platt, Pomologist of the Board. An opportunity for testing fruits and exchanging scions will be offered, and specimens and scions of choice varieties are solicited. Please make a worthy exhibit.

Fruit Growers are especially invited to contribute fruits carefully labeled, fruit photographs, lithographs, casts or models, implements used in culture, pruning, or gathering of fruits, new or improved packages for shipment, and cultivators generally, to bring or send collections of Corn and other agricultural products, Nuts, Syrup, Sugar, and Honey; Corn, three ears each variety, tied in a bundle; samples of Butter and Cheese, both Farm and Creamery, are especially solicited.

All articles for exhibition may be sent by express, at the expense of the Board, to the Secretary at Meriden, to arrive on Tuesday, December 12th.

RAILROAD ARRANGEMENTS.

The N. Y., N. H. & Hartford Railroad will return, on certificate of the Secretary, at half rates over all their lines, those attending and paying full fare by tickets or mileage. The certificates to be exchanged for tickets at Meriden station.

HOTEL ACCOMMODATIONS.

The Winthrop Hotel, double, . . .	$2.50 per day.
The Winthrop Hotel, single, ...	3.00 " "
The Meriden House, double, . . .	1.75 " "
The Meriden House, single, . . .	2.00 " "

Gov. GEORGE E. LOUNSBURY,
EDWIN G. SEELEY,
T. S. GOLD, *Secretary,*
Committee of Arrangements.

WEST CORNWALL, Nov. 3, 1899.

REPORT OF THE PROCEEDINGS

OF THE

Farmers' Convention

CONNECTICUT STATE BOARD OF AGRICULTURE

At MERIDEN, CONN., December 13, 14, and 15, 1899

Convention called to order at 11 A. M., December 13th, Hon. T. S. Gold, Secretary, acting as temporary chairman.

Secretary GOLD. Mr. Edwin G. Seeley, our Vice-President, will preside this morning.

The PRESIDENT. Dr. Anderson will lead us in prayer.

Dr. A. ANDERSON. Let us unite in prayer. Almighty God, Thou who art the Creator of all things, and the Author of all good, we gather this morning under the auspices of this association in Thy name; and we come to Thee acknowledging our dependence upon Thee, for in Thee we live and move, and have our being, and without Thee we can do nothing. We come to Thee for Thy blessing, and we acknowledge Thee, O God, for Thou art the Maker, and the Preserver, and the Redeemer, and we praise Thee. And in our praise we are consistent with that harmony which rises up before Thy throne from all nature, for it is good for all created things to praise Thy name. And so we, under the inspiration of Thy Word, and because of Thy guidance, render Thee the sincere homage of our hearts and call upon our souls and all within us to bless Thy name.

We thank Thee, O God, for the goodness of Thy hand. We thank Thee that Thou sendest the rain, and that Thou

sendest it in the summer time and winter, and for what Thou hast done for us in the appointment of the seasons, which never fail, and of this are we constantly assured, and that Thou wilt indeed make to Thyself praise because of the constant blessings which flow from Thy hand unto the children of men. And we ask Thee, then, that Thou wilt accept of us as here we acknowledge Thee, whom the Heavens praise, and of whose praise the earth is full, and to whom the hearts of men render praise. We pray that Thou wouldst accept us and grant unto us Thy favor, and fill us with testimony unto the blessings of Thy spirit, that we may duly acknowledge Thee in all things. We pray Thee that what work we may accomplish shall always be consistent with such plans and purposes as Thou art carrying out on the broad scale of the universe. Help us always to remember that Thou wilt teach us, if we will only learn, not only by the words that Thou hast inspired, but by the things that grow; and we bless Thee because we may so train ourselves that out of the earth we may receive that which goes to bless and build up our physical lives, and because Thou hast taught us where to find in earth the suggestion of that power and that goodness upon which we are dependent, and upon which we are to depend if we would grow in moral stature, and we shall come to see Thee, and to acknowledge Thee, and serve Thee. We are dependent creatures, and the earth teaches us daily the lesson of our dependence. We pray Thee, then, that we may accept of the blessings of Thy hand, and that we may accept of Thy kind providence; that we may accept of that which Thou art constantly doing, and in the midst of which we are constantly moving, and may we accept it as an indication of what Thou wouldst have us become, and realize, even as we would glorify Thy name.

Bless, we pray Thee, this association; and grant that in the hearts and minds of those who shall lead and teach, and those who are gathered here to study the things of God, may there be Thy guidance, and may such things be accomplished as will

lead us through our doing, and our serving, to higher plans of life; to higher plans of living and of serving. Help us to understand thoroughly and comprehend more and more clearly the mutual relations we sustain, one to the other, and help us to feel sincerely that, dependent as we are one upon another, yet we are dependent altogether upon Thee. For no man liveth to himself, and no man dieth to himself, and whether we live or die we are Thine.

Hear us, and forgive us, as we are asking it in the name and for the sake of Him who taught us to pray " Our Father, who art in Heaven, hallowed by Thy name. Thy Kingdom come, Thy will be done on earth as it is in Heaven. Give us this day our daily bread, and forgive us our debts as we forgive our debtors. Lead us not into temptation, but deliver us from evil, for Thine is the Kingdom, and the power, and the glory, forever." Amen.

The PRESIDENT. We have had a beautiful burst of welcome in the sunshine this morning, which has come out as we have been gathering to this place. But now the city wants to bid us welcome. Nothing better than that can be, and we will listen now to an address of welcome from the Mayor of this city, Mr. Ives.

Hon. AMOS IVES, Mayor. Mr. Chairman, and ladies and gentlemen. It is no uncommon thing for history to repeat itself. Five years ago I stood before you in many respects just as you see me to-day. I was here then to meet you, to greet you, and give you a warm and hearty welcome, and I am here this morning for the same purpose, and with the same feelings in my heart, and if it be possible I would like to add such emphasis to it that it will echo and re-echo within these walls during the entire time that you remain here. Yes, more than that; I would like to have it follow you to your homes and live with you, and act as yeast that will raise your desire to come again. And not only do I greet you and welcome you, but in my official capacity I extend to you the full freedom, the

liberty, and protection of our city, and I hope and trust that you will receive such hospitality as will cause you to rejoice that you selected Meriden as the place to hold this convention.

As a representative of Meriden I feel that I can speak for the people. We would not be unmindful of, nor fail to thank you for, the great advantages that you bring to us, and we may well congratulate ourselves upon our good fortune in having this convention held in our city.

I have not studied your program, but I remember seeing somewhere that His Excellency, the Governor of the State, and others in high authority are to be present and take part, and I feel that it is safe to say that the very best talent, and the ablest men in word and deed, from all parts of the State, and from beyond its borders, are expected to take part in the discussions and lectures, and I predict that this will be one of the most entertaining, instructive, and profitable of all the gatherings you have ever had. The study of agriculture is a subject that interests all of us, and when we remember that all wealth and all the necessities of life come from the ground, it is highly proper that we should acknowledge our allegiance to mother earth, and I believe that every person should feel it a duty to improve it in some way.

We are a progressive people. The watchword of the day is study and work, and the result is that we who started on life's journey fifty or more years ago have witnessed some wonderful changes, not only in the agricultural world but in the realm of manufacturing as well. The man who would attempt to carry on farming on the same plan, with the same tools, and in the same way that it was done fifty years ago would certainly be considered a back number and a failure. These are days of activity, improvements, inventions, and hustle. It is not so much a question of what we shall do, but the imperative demand is to do something. The man that is willing to waste his time and do nothing will find that others have gathered what they want, and very little is left for him. The manufac-

turer of to-day must be constantly on the watch, and doubly active, and let me say right here that I believe Meriden, with no natural advantages, and only one railroad, has been made what it is by the real push and enterprise and energy of its manufacturers. I think you will agree with me that the drones are not found in the front ranks, but are wandering about unsought; while, on the other hand, the young man who is willing to shoulder as big a load as he can carry, and walk strongly off with it, showing to the world that he is possessed of will and determination, is the man who will prove himself useful, and will always be looked up to and admired.

My life until my majority was spent on a farm, and I am glad to notice that great improvements have been made since that time. Agricultural, horticultural, and pomological, and other societies have been organized to study for the advancement of this great work of husbandry, and I say to you Godspeed. May it go on from year to year, and grow richer and more interesting, for I believe that there are yet large fields unexplored.

Gentlemen, at this point may I dare to suggest that your light should be placed to the advantage of the greatest number. Are there not some that are a little sluggish and slow that might be aroused and interested, and when so interested would become better farmers and might be valuable acquisitions to society?

Now, ladies and gentlemen, if you will allow me a few minutes to notice some things pertaining to our city I will cease to annoy you by keeping you away from the intellectual feast that is fully prepared for you. I am glad to say to you that our industries are all busy, and this means a great deal. It naturally means something for capital employed, and it certainly means that the workingman can have his weekly pay with which to buy the necessaries of life for himself and family.

I am glad to report that our city has been connected by a trolley road with Southington, Plainville, and other towns to

the northwest, which is a matter of great convenience and comfort.

Now, if you will pardon me, I want to say one word about "Hubbard Park." An ideal spot, more especially in the summer, where you will find nearly one thousand acres of mountain and valley, with beautiful brooks and lakes, and trees of every kind, and mammoth rocks. These are the handiwork of nature, but in the last two years there have been built in this park miles and miles of most beautiful drives and walks, fountain after fountain has been placed, pavilions and walls have been constructed, trees have been trimmed, rubbish cleared away, grading done, flowers planted and grass grown, and in the midst stands a high staff with "Old Glory" streaming from the top. For all of this the people of this city are making their prettiest bow to the benefactor, Mr. Walter Hubbard.

It gives me pleasure to state that our churches and schoolhouses are kept in repair, and the good work of persuasion and instruction goes on. While it may not interest you, it is exceedingly gratifying to me that at the end of the year of city business our indebtedness has been decreased more than $50,000.

In conclusion, permit me to say, speaking for the people of the city of Meriden, we feel honored, and we are proud of the company that visits us on this occasion. We realize that there is no class of men in the world who are more independent, or who have a higher sense of sociability, or more good fellowship to the square inch than the intelligent tillers of the soil, and I hope the people of Meriden will realize and embrace this opportunity to give and receive information and show an open-handed and warm-hearted hospitality.

Mr. Chairman and gentlemen, I hope nothing will happen to mar the convention in the slightest way. I hope every one will feel that it has been pleasant and profitable for us to mingle together, and may it redound to the good of the whole people.

The PRESIDENT. Ladies and gentlemen, I now have the

pleasure of announcing to you that Governor Lounsbury is with us and will give us an introductory address.

Governor LOUNSBURY. Ladies and gentlemen: A while ago, impelled by curiosity, I spent a day in a courtroom where a celebrated will case was on trial. When one of the leading witnesses had gotten through his direct examination and was turned over to be cross-questioned by the opposing counsel, he was asked how much of his life he had given to the study of the matter concerning which he was giving evidence, and whether he considered himself an expert. He said in reply that he had spent so many years in investigating the subject that his friends counted him an expert, while his enemies called him a crank. Now, as I looked over your program I saw that with the exception of your servant every one of your speakers was booked for an essay on some subject in which he or she has justly won the fame of an expert, while my colleagues on the committee have put me down for some simple introductory remarks. It was a pretty broad suggestion that my knowledge on any agricultural subject was so little known that in it I had not even attained the notoriety of a crank. If I had ever doubted the fact that diseased milk is the rare exception; if my ancestral herd had not for sixty years defied disease, and succumbed only to the rare stroke of the lightning and the frequent stroke of the butcher, they might have put me down for an essay on tuberculosis. If the hundred peach trees which I grow for fruit for the family, and for fun rather than for profit, had expanded into orchards that blossomed from the hills of Glastonbury to the highlands of Georgia, they might have booked me for a discourse on peach-yellows. But, gentlemen, do not think for one moment I am complaining. I thoroughly realize the truth that I am a member of your association, and of this convention, for no other reason than because I happen to hold, for the time being, a certain office, and thousands before me have keenly felt the fact that a man who occupies a place "*ex officio*" holds a position which has point, but not one bit of magnitude.

I have tried to ascertain what is expected of me here to-day, but all that I have been able to find out is this, that I must make some sort of an introductory speech, and that it is expected that I will say something pleasant about the farmer. But I have been cautioned, even in this, to be very brief, and I was told that any " taffy " which I might give you to-day must not be " sweetness long drawn out."

In this world of unequal opportunity and information it is fortunate for the feelings of some that exceptional wisdom is extremely limited in its degree, and more than once in my life I have been glad that there is truth in the old proverb "A fool can ask more questions in a minute than a wise man can answer in a lifetime." I was happy to learn that in your meetings here questions were not only permitted, but they were also invited. And so I will ask now, to be answered later on when the Pomologist of this gathering makes his address — I will ask two or three questions, the reasons for which date from my early boyhood.

A little less than fifty years ago my father set out an apple orchard, and I, a lad of ten or a dozen years, held the trees as he covered the roots. Of these trees there were ten which he had bought for Baldwins, but which proved to be Northern Spies. These ten trees took on a rapid growth, and in a few years were bearing apples at the annual rate of a barrel apiece; an average which soon increased to two, three, and four barrels. All the trees seemed to have the same thrifty growth, but from the start the apples from one tree were beyond all comparison finer than those which grew on the other nine. They were richer in color, more beautiful in form, and, with the same care, would keep sound three months longer. Time and again, with no benefit from cold storage, I have kept apples from that tree until the fourth day of July. Now, what made this difference? There was the same soil, the same climate, the same exposure, the same culture, the same care. Was it not the original stock into which the Northern Spy bud was

grafted? And if this is so, why will not careful and continued experiment bring out the truth and enable us to grow trees whose fruit will not rot before it is picked, nor go to pieces in the warm days of later autumn? Are our nurserymen as anxious as they ought to be with experiment to perfect existing varieties of fruit, or are they so intent on the discovery of new varieties that they are inserting buds with no knowledge of those certain, though perhaps hidden, laws which in the union of bud and stock fix the beauty and endurance of fruit?

I will try to make my second question shorter, though that, too, dates back to the days of my boyhood. Those of you who were born not less than fifty-five or sixty years ago remember the peach trees that grew in our gardens, and along the fences of our fields. Many of them bore fruit as luscious as the average peach which we see in our markets now. Their blossoms were as certain as the robin, and their fruit as sure as the approaching days of autumn. The thermometer shows that there is no change in our climate, and our soil remains the same. The only change is in the tree, which in those days grew from the pit, but which now grows from the bud. Since I was grown, my father set out a little orchard of fifty trees which grew without budding from the pits of a native tree which stood upon our farm and that bore fruit of a superior quality. Every one of those fifty trees produced fruit exactly like the original, and for fifteen years in abundance, and during all that time there was not one Connecticut winter which blasted the buds. In sixty per cent. of those years our neighbors did not have a single peach. The budded trees were a failure. The trees which grew from the pits were a success. It is certain that there are some peach trees which always through their pits reproduce their own kinds of fruit. Is it true, or is it not true, that no matter what may be the vitality of bud, or of stock, there is in their union some natural law which makes the peach tree more delicate, and less able to endure the severity of frost? Would it not be well if our Connecticut nurserymen should

more frequently plant the peach stones from choice native trees, not for the purpose of budding, but for the purpose of raising the fruit?

I will say just a few words of Connecticut farming, so far as it is a vocation, which should be handed down from father to son. A few months ago I passed the day with one of the best farmers of the State. He was proud of his calling and had won success, not by inherited wealth, but by inherited brains and energy, and he had proved that a Connecticut farm wisely managed still pays. But he was lamenting the fact that so many bright boys were leaving the farms for the factories, the cities, the professions, and the distant West. I told him that we were forgetting the fact that it was always thus; that for generations sons of farmers have stood in the front ranks of all the professions, have been foremost in the factories, and in all the centers of trade, and have led in the grand march of civilization itself. We shall begin to have reason to fear that our Connecticut farms are not a success when in any generation they fail to send out hosts of sons to give life and character to the vocations of factory and trade; to stand at the head of institutions of learning, and to grace and ennoble the professions of medicine, of theology, and of law. You have the blood that came down to you through ancestral veins. Your calling stands for independence, and develops love of liberty, and neither in politics, in religion, or in social life do you call any man master. You are broadened by a daily study of the laws and the forces of nature. You breathe the pure air of heaven. Beneath you is the earth which God has made your servant, and above you there is nothing but the Lord of Hosts. Is it not true that other places less favored than these Connecticut hills have a right to ask that you should give to them from your surplus of energy? Is it not true that if on these hills you live right you will give to your children not only inspiration of honesty and impulse of energy, but also that desire to better their condition which God has ordained to be one of the chief

factors in civilization? It has been to this country and to the world a blessing beyond estimation that sons of New England farmers, with New England ideas and New England energy, opened up the great West into states that stood for the Union, for liberty, and for progress. But it is true that not every bright son of the farmer is fitted to be a missionary of civilization, or to succeed in any walk of life outside the farm. In the shop, in the store, and in all the professions there is many a man suffering the bitterness of disappointment, and ekeing out a scanty living, who might have been happy and successful on his father's farm. All that you can do to prevent mistakes like this is to bring up your boys with a full knowledge of the situation at home, and to help them to make a just comparison between their prospects for success on the farm and their prospects for success in the outside world. Help them to realize the truth that the man from the city who drives by with splendid equipage is the rare exception, and that for every one like him there are a score living in apartments which the average farm boy would despise. Show them that the men successful in manufactures or in trade are only five in a hundred, and that in the professions men of comparative success are far outnumbered by those of comparative failure. Impress upon them this truth, that there is no poverty more bitter than that which is experienced by men who are unsuccessful in the professions. On the other hand, if you are proud of your vocation and successful in it, let your boys share in the pleasure of your success, and do not sour their young minds against the farm by too much hardship and too little of appreciation. Realize yourselves, and make your children realize, that in proportion to his capital invested the farmer receives more consideration from the world than is given to any other man of business. Teach your boys these truths, and then if they leave the farm they can cast no blame upon you. They will learn perhaps from the bitterness of their own experience, and perhaps they will surprise you with their success.

The PRESIDENT. Now, I am almost surprised to find here in the title to this next address which we are to have one word in the way. It has been in the way a great deal of late. You find it in the way of natural affairs, and of supernatural, or theology. Sometimes it's evolution, sometimes it's expansion, sometimes it's imperialism, and sometimes it's something else. Now we have got a man here who can tell us all about this "evolution" in farming which has made so much trouble in most everything else. We have got a man here to tell us about it who was living and who has kept living almost ever since it began to be heard of. I remember hearing him when I was a young man and just commenced farming. I remember that the first lecture that I ever heard him deliver was to show what we could get out of coal tar. Everything under the light of the sun to eat and wear and drink almost; and I said then that any man who could get into that nasty, dirty, filthy substance and bring out what he brought out at that time was tolerably well conversant with his subject. I have heard him speak since, when I felt assured that he was tolerably conversant with what he was talking about, and now that he is to talk about "evolution," I feel assured that we will all have that impression. Don't think he is not orthodox because he is going to talk about evolution. Now I am happy to introduce to you as the man who is to speak to us on "Evolution in Farming, the Old and the New," Professor William H. Brewer, a Yale man, of New Haven.

EVOLUTION IN FARMING, THE OLD AND THE NEW.

By W. H. BREWER,

Professor of Agriculture in Yale University.

It has become common to speak of the new agriculture as contrasted with the old. Agriculture itself is older than history, older than civilization itself, and yet there has perhaps always been, since the very first community practiced it, a new agriculture as contrasted with the older one.

Agriculture as now generally understood consists of producing cultivated crops and domestic animals. These supply the food for all civilized peoples. From the very nature of the case, agriculture had to begin before there could be any civilization, and it will have to go on as long as civilization lasts. The two have grown and developed together and must always exist together, each essential to the other. It is the most stable and the most permanent of all the arts and industries, but, like all others, it must change to suit the times.

From the nature of the vocation it has some features peculiar to itself which are so unlike those which prevail in all the other chief industries that certain important rules will not apply to it and them alike. Like all other productive industries, it must change to suit changing conditions, that is, to suit the times, but from its very nature it can never change rapidly. It is the slowest to change, and yet it is the most plastic and susceptible of change. It will and must adapt itself to all sorts of conditions. It yields to every outside pressure, whatever that pressure may be. It is always changing and trying to adjust itself to the times, and yet it always lags behind the changes which may be going on in the other productive industries. Laws may oppress the people, the country may be troubled, seasons bad, and the soils ungenerous, but this industry goes on.

Manufactures of one kind or another can rapidly grow up and men in them grow quickly rich, but new inventions may come in and stop the business, the product may cease to be used, or oppressive laws may so badly hurt the business that no change will save it. Not so with agriculture. It cannot be killed, however badly hurt. So, too, with trade — times may be good and trade flourish, in fact, it always does when crops are abundant, but a war may come and crush it, or oppressive laws may smother it completely. Not so with agriculture. If it should cease for a single year most of the civilized inhabitants of the globe would starve to death. Agriculture must and will go on, however hard its lot may be or what else stops, it must go on and it will go on in some shape. It will slowly and laboriously turn itself and groaningly adjust itself to the new conditions imposed, and then carry the new burdens. No conditions have ever yet been imposed which were so hard that it did not survive, and it will go on so long as there are men to toil and families to feed.

Heretofore in the history of the world the greatest calamities to agriculture have come from some sudden or unusual natural disaster, such as droughts or floods or diseases of crops. War may oppress it, and then comes distress or even famine, as has often happened in the history of our race. Such has been the history of the past, but within our own lifetime a greater and more widespread trouble has come upon it from the rapid growth of civilization itself. The causes have been social and economic rather than from the destructive interferences of physical nature or of war. During our own lifetime greater changes have come into the business world, through invention and the discoveries of science, than during the thousand years preceding. Steam transportation, more particularly on land, has entirely changed the conditions of commerce and competition in agricultural products. The business world has so rapidly changed and new inventions and discoveries been applied that all the other productive arts and industries have been revolutionized. All of this has taken place much faster than agriculture could change. Manufactured products have increased faster than agricultural products could, and during the same time all the old conditions of competition in agricultural products have been changed. Moreover, the means for the investment of capital have so enormously multiplied that agricultural land as an investment has lost the dominant position it had held for many centuries, and all this has gone on faster than this conservative industry could adapt itself to the rapidly changing conditions in the rest of the business world.

Men of affairs continually tell us that the trouble with the farmer is that he does not adopt the modern methods pursued in other industries, that the same economic laws govern agriculture that pertain to other kinds of business, that the farmer does not specially consider this, and therefore he suffers. There is some truth in the statement, but it is far from being the whole truth. It is true so far as the trade and commerce in his products is concerned, but not true so far as production is concerned, and the farmer is essentially a producer rather than a trader.

A very different set of conditions pertains to the production of crops from that which pertains to the production of most manufactured articles. The difference extends also to the re-

lations which the various productive industries bear to the land or the locality where the work may be carried on, and most of all it differs from them in its relations to the weather, a factor over which man has no control and the character of which he cannot foresee. Let me illustrate what I mean.

The cost of production of grain and other agricultural products has long been a subject of study and speculation. Because of the new features introduced into agricultural competition by modern methods of transportation this constantly recurring question is assuming fresh importance, and has from time to time been made the subject of investigation by individuals, organizations, and official commissions. The result of recent investigations has been no more satisfactory than formerly, when different conditions of competition prevailed. Agriculture and manufactures agree only in a most general way; in nearly everything that regards details of production, even the most important, there is much conflicting statement and discrepancy of estimate of cost.

The introduction of labor-saving machines so largely into farming has brought this industry in its business aspects nearer to that of the manufacturing industries than heretofore, and many business men who are not farmers have come to assume that the same principles underlie production in both, and that the cost of the production of crops is as susceptible of accurate calculation as is the cost of manufactured articles.

Although the two classes of industries now more closely resemble each other than formerly, they nevertheless remain as unlike in the principles of production as ever, and the uncertainties of the estimates alluded to are inherent to the vocation. In manufactures, everything used is bought in the open markets; all the buyers fare essentially alike, the most of the processes and conditions of manufacture are under control, the manufacturer can very closely predict beforehand how much he can produce in a year, and very nearly what it will cost him to produce it. The cost and quantity of his manufactured article can be closely calculated before the thing is made.

This is not true of anything produced in agriculture. In certain phases of farming we can accurately give the cost of the product after it has been produced, but we cannot calculate beforehand how much we will produce, nor what it will cost. On a large Dakota wheat farm, or on a California fruit ranch,

where the farmer grows but a single kind of crop, buying everything he uses in his business and paying for it with the proceeds of that one crop, the profit or loss on that crop can be accurately stated after it is sold. If but two kinds of crops are grown, it may not be possible to state the actual cost of each separately, but still it can be closely approximated, and that only after it is ready for market, not before it is grown. The fewer the kinds of products grown on any farm, the nearer we can calculate what it has cost to produce each one, but along with this the business becomes more speculative in character. When the cultivation is reduced to but a single kind of crop, although the profit and loss on that crop can be ascertained, yet its growth is speculative, because the yield depends upon weather and other conditions beyond control, and which cannot be predicted when the expense is incurred. With mixed farming all this is even more pronounced. The profits are never so high as they may be with a single crop in favorable years, but the greater the variety of crops, within reasonable limits, the fewer the liabilities of absolute failure, and, correlated with this, the more difficult it becomes to calculate the cost of any one crop separately, except in a very general way and for a considerable term of years as a whole.

It is in mixed farming that agriculture differs most widely from manufactures. Agriculture is so adaptive that it cannot be destroyed; manufactures can. The country may have excellent natural facilities for certain manufacturing operations, and yet hostile laws or established and organized competition may utterly prevent such industries from starting, or kill them after they have long been in successful operation. Not so with agriculture, and I wish to keep this feature before you. If the natural conditions are favorable, nothing can kill it short of exterminating the inhabitants. If the country retains a civilized population, no matter how hostile the laws, how sharp the competition, or what its nature is, it will go on in some shape, and generally in the shape of mixed farming. This is so perfectly plastic that it molds itself to every surrounding pressure and adapts itself to every imposed condition, and if in intelligent hands and perfectly free it will ultimately go on profitably, as a whole. Farming will never be abandoned in any fertile country.

The success of mixed farming everywhere depends upon

its adaptability, and the profits of each farmer must be measured by the general result of his business as a whole for a series of years, rather than by the success of any one crop for any one year, or even for two or three years. No crop is profitable every year; each fails from time to time, and so the profitableness of any one can only be determined from practical experience for several years. And when at last it becomes certain that, as a whole, a crop does not pay, it then, and only then, is entirely abandoned and some other is substituted. All this takes time.

The difficulty of rapidly changing agriculture to adapt it to new conditions is inherent to the business. It has been all through the previous ages, and neither modern science, nor art, nor new business methods have changed this great law. It has been able to advance only slowly, much slower than pertains to most other means of acquiring wealth. The century now so near its close has seen very much greater changes in the methods of transaction of business and in the means and appliances for producing the necessities and luxuries of our civilization than in the twenty centuries which preceded it. It is during the last half, however, that this has gone on most rapidly, and agriculture has been put to a greater strain than ever before since the world began. The greatest factor in this has been the change that has come about in facilities for transportation by railroad and in the appliances and methods for handling, preserving, and moving the raw material grown on farms, more especially of food products.

The older men of this audience can remember when there were no railroads bringing grain from the prairies of the West. We carried our Civil War through without a can of vegetables being served to the army. The canning of vegetables, the shipping of fresh meats, cold or frozen, the bringing of perishable foods and fruit entirely across the continent, the transportation of products as frail and as decomposable as eggs from beyond the Mississippi River is all a new thing. It has all come about during the last forty years. Before that the farmer's greatest competition was only with his own neighborhood or vicinity. Now every farmer has to compete with lands thousands of miles away, even in perishable products that need to be delivered fresh to customers.

The cost of railroad transportation where the hauls are

long, or of water transportation by the modern methods, has been so marvelously cheapened that it has resulted in changing the distribution of population in all the countries of Christendom. Cities can now be fed from land on the other side of the globe. As matters were when farm products had to be transported by wagon, even grain and flour could not be profitably hauled more than a very few miles. A barrel of flour is now brought from Minnesota to New England for about the same sum that the customer would be asked to pay to haul it by wagon from the cars to his house. A few years ago I investigated the matter relating to this and found that it would cost a baker in Boston, using flour from Minneapolis, about as much to deliver the bread made from that flour to his customers as it would to transport the flour itself from Minneapolis. This was also nearly true in London. In the ultimate local distribution of food, like bread, or milk, in the cities, the cost has not been so much diminished, but in bringing the raw material from great distances the cost has been marvelously reduced. As a consequence, the farmer now competes with the whole world in the production of products, whereas his sharpest competition in all the ages before had been his own neighbors. All this has come faster than he could intelligently change his methods and his crops to suit the new and rapidly changing conditions of competition he was compelled to meet.

But this is only one of several great changes affecting farming, both as a whole, and also affecting every detail, and where the changes have come on faster than the farmer could keep up with.

The New England farmer has been hurt as much in his capital invested as in his crops and competition. For hundreds of years farm land had been the most safe, fixed, and stable of investments. It was not only the greatest in amount, but the one least liable to serious or sudden change. If an enterprising farmer wanted to borrow money he could do this on the best of terms, because his farm land was the very best of securities. Most of the wealth of the world was invested in agriculture or in handling its products. When I was a young man and came to Yale to study agricultural chemistry, one of my text-books was "Johnston's Lectures on Chemistry and Geology Applied to Agriculture." Chemistry was then just coming to the front as a great aid to the farmer, and the learned

author speaks of agriculture as not only that industry on which millions of men are dependent for their very food, but also as "that art in the prosecution of which nine-tenths of the fixed capital of all civilized nations is embarked." Now how this is changed. The multitude of other means for the investment of capital have changed entirely the direction of popular investments. Then if anyone had a few hundred or thousand dollars to invest he wanted it put where there was land back of it. Everything else might fail, but farming must go on, land was sure to be wanted, and money in it was safe. Now the investor usually wishes to put his money in stocks or bonds or some one of the various other forms of capital where the investment can be rapidly changed if desired.

Then the farm was the safest of investments, but the last thirty years have seen an enormous decline in the value of agricultural lands in all old countries. The oldest lands have been put in active and sharp competition with new lands thousands of miles away. The value of farm lands has fluctuated almost as much as stocks. Then land was the safest, the most enduring, the least fluctuating, and most desirable of investments. All this is now passed away, it no longer holds a dominant place as an investment; this is gone, probably, forever. This is not a matter local to New England; it is a form of agricultural distress common to all old countries.

I may say, however, that fluctuations in land values go on in city as well as in country. It is not confined to agricultural land. Some years ago I gave a talk at one of our agricultural conventions held by this Board, on the subject of farms as homes, in which I took the ground that agricultural land in the country had of itself no value except that given it by the user. Land has value for cultivation and for homes. Its fluctuations in value are caused by the demands of business, and while farming was the chief business of the world its capital was necessarily the most stable. Now, as other forms of investments have grown, and as one consequence, there has come about these recent great fluctuations in land values. We can, however, believe that no other so great change can ever again, on so wide a scale, so rapidly occur, as the last half-century has seen, and we may believe and hope that during the century now coming farm land will again rise and be again of more stable value.

There are various other factors which have aided in the rapid change I have been discussing. The far-reaching effects of the changes in transportation, accompanied with the advances suggested and brought about by science, may be illustrated in many ways. I will give another illustration.

Damascus, the oldest city of the world, has about it land where madder has been extensively grown for many centuries. This is the raw material from which a valuable red dye is made, and it has for ages been an important commercial crop of that country. Our chairman has alluded to a lecture he heard me deliver some years ago on coal tar and its products. When I delivered that lecture madder was the chief agricultural export of that part of Asiatic Turkey. But its coloring principle is now made by chemists from coal tar, and the farms about Damascus are suffering more because of their new competition with the chemists than the farms of New England are because of our competition with the Western prairies.

There are also many other phases of the change of conditions to which the new agriculture is asked to adapt itself. The growth and expansion of nationalities is another factor. It has affected the modern farmer in his competition, in his production, and in the stability of his invested capital. Modern times have seen great changes in national boundaries. The greater nations have absorbed the lesser ones and become more powerful, and this makes all kinds of property more secure and modifies the conditions and risks of trade and commerce. Along with this is the very rapid growth, during the last dozen years or so, of the sentiment for territorial expansion so well illustrated in the partition of Africa among the nations of Europe, and our own acquisition of new lands. All these affect both agricultural competition and investment in farm land.

As the nations have grown larger and stronger, the times have become more peaceful, and personal property more secure. When nations were small and each one often fighting with its neighbor, and communities hoped to get rich by plunder, then personal property was insecure, because it could be more easily destroyed or carried away by the invader, and farm property was more secure, because it could neither be destroyed nor carried off. Moreover, it had to feed the people, if any were left in the country. Now that

nations are fewer but much larger and stronger, there is less destruction and plunder by war, and this is one of the reasons for the rapid accumulation of personal property in these modern times, and why land has lost its old supremacy over other property as an investment. Farm land was then more stable in value as contrasted with personal property, largely because the nations themselves were more unstable than now.

We must remember, too, that land values in cities have fluctuated as much as they have in the country, indeed more so. There is fluctuation in all kinds of investments. I am only illustrating to you that farm investments have become more like other investments in these modern times, and that the farmer has lost certain advantages he formerly had.

Again, the farmer of old had to be master of many more arts than now. He was usually a mechanic and a manufacturer as well as a farmer. He made a larger proportion of the tools used in his business and the food used by his family than now. Even his clothing was largely produced and made on the farm. All of the older men present can remember the time when farmers were clothed in wool raised on the farm and the garments were made at home. In those days much was said about the "independence of the farmer." He grew his own food, he produced much of his own clothing, and, with but little bought from the outside world, he lived as comfortably as his village neighbors did and often more so. He was the independent man par excellence, especially in this country.

All this has passed away — probably forever. He now buys more, so he must sell more. He must be less of a mechanic and manufacturer and more of a farmer, and also more a man of affairs. He wears better clothes, he drives in better wagons, he eats better food to-day, but he has to pay for this by the loss of his old independence. He is to-day no more independent than is a man in other vocations. He is subject to the same kind of dependence that others are. He may be oppressed by corporations, by trusts, by various aggregations of capital, as other people are, and under the new conditions he can only regain his old independence by sinking to a lower level in his home life, his home comforts, and in social position.

The new farming is well on its way to a new adjustment; this is its most hopeful feature. The distress has borne hardest on the old farmers. It was their land that decreased in value,

and it was hard for them to change their methods. It was asking a person skilled in one business to abandon it, and with the outfit used in the old business begin a new one.

The young men do not have to unlearn an old trade and learn a new one, they are beginning under the new set of conditions. The old land values do not trouble them, they begin with the present values. They stand in a condition of affairs somewhat similar to the one we see going on in railroad management and railroad ownership. It often occurs that a railroad is built and does not pay the stockholders. The share of stock which cost the builders one hundred dollars runs down and is worth fifty dollars, then twenty dollars; it may run down to five dollars or nothing. The road cannot possibly pay interest on par values. Now comes an enterprising modern railroad man, alive to the new situation, who buys up the railroad at its depressed value. What had cost the builder one hundred dollars costs him but twenty dollars (it may be but five dollars), and he builds it up anew on that new base of capital and makes his money out of the new growth. We all of us hear and know of great fortunes that have been built up in that way. Now the young farmer has the old farm taken at a new appraisal. It was the former owner that suffered the losses due to lowering of land values. Farm lands in Connecticut will not probably run down any more; they are apparently now on the upward trend. Of course, there are some lands that once paid for cultivation, under the old conditions of competition, that will not now pay to cultivate, just as there are many old mill-privileges in this State that were once valuable as power for manufactures but are worth nothing for that use to-day.

Farmers are often told that the new farming must be more specialized. This is truth, but it is not the whole truth. Highly specialized farming is apt to be in a condition in which too large a proportion of the farmer's income is staked on one crop. As already shown, that is much more speculative than mixed farming, because of the uncertainty of the seasons rather than the uncertainty of the markets. No kind of farm crop is good every year, and here in New England the seasons are never so bad that all crops fail in any year. So the Connecticut farmer must, as a rule, continue to raise several crops as a sort of insurance that he will have something to sell, even if his chief reliance fails. With markets at our own doors for almost

everything the Connecticut farmer raises, he can have something to sell every year, but for this he must, as a rule, pursue mixed farming, although he may have one dominant crop as his main reliance.

In all ages the farmer has been especially subject to plunder. In the early stages of civilization, barbarians would steal his crops. Fields could not be walled in for protection as cities were. The modern enemies of the farmer are more often of his own country, such as combinations of capital, combinations of middlemen, etc., who absorb the profits on his crops, if any. Great corporations and trusts too strong for him to fight oppress him. We all hear much about oppressions by capital and by trusts, and by corners, and severe legal remedies are recommended and attempted. That there is here a great evil bearing heavily alike on the farmer-producer and on the consumer of his products no one denies.

I am not wise enough to suggest a remedy. I consider it the hardest problem now presented to communities and states. I addressed some of you on this subject at a convention more than twenty years ago, in which I assumed that it was the great problem presented to our modern civilization, and the most difficult to overcome. That it was a struggle of the many who are oppressed with the few who are the oppressors, just as it was in the previous struggles which our civilization waged against ecclesiasticism, against feudalism, and for constitutional governments.

Those are now settled, and the new one is before us. As to how this is to be remedied, I am to-day no wiser than I was then. It cannot come through laws forbidding combinations of capital; it is through combination that modern trade and manufactures have enormously advanced. It cannot be brought about by severe laws forbidding men to combine in order to increase or diminish prices of products. If it is wrong for dealers and tradesmen to combine to regulate the prices of their goods, then it is also wrong for the farmers to combine to get fair prices for their milk or fruits. I have no remedy to suggest, but I believe that we will work out this problem in the evolution of our civilization as we have overcome other great evils in ages past.

In all the countries of Europe there is a peasantry on the land. The term peasant is rather vaguely applied and has

somewhat different limitations in the several countries, but everywhere the peasant is of inferior social position and usually of inferior political rank. The peasant belongs to the country or to agricultural villages as distinct from the lower classes in the cities, and he is usually employed on the land rather than as a craftsman. The class is a very permanent one. It is very difficult for a peasant to rise into a higher grade in society or to a higher political position. In all those countries many of the peasants own the land they cultivate. This is especially the case in France and in Belgium; nevertheless, they are universally considered as belonging to an inferior class of the population.

In Great Britain for several centuries there has been a class termed yeomanry, lying between the landed gentry above them and the peasantry below them in the social and political scale. In the previous centuries this has contributed an especially important part of England's progressive men. As a class it may be described as land-holders carrying on their own business rather than as landlords. From that class came a very considerable portion of the early English emigration to the colonies of New England.

The burgher class, which constituted an important part in the settlement of New York and New Jersey, was a city class rather than one from the country, and bore the same relation to the greater merchants that the yeomanry did to the landed gentry in Great Britain. In both cases it represented an intelligent, industrious class, not rich, but owning property and carrying on business on their own hook. The burghers of New York under the Dutch administration largely became yeomanry under the English administration.

As I have said, peasantry in the Old World everywhere belongs socially to an under class. Fortunately, we have never had a peasantry in this country; the farmers represent a yeomanry, although that term has entirely dropped out of use. It was in common use, at least in the State where I was born, until into the present century. My own grandfather and his father before him were described as "yeoman" in legal documents of the last and early part of this century. My impression is, although I cannot say positively, the term dropped out of use when a property qualification for voting was done away with. As matters are now, and have been during the lifetime

of our present population, the farmers have in the United States not constituted social classes in any way corresponding to the yeomanry and peasantry of the Old World. There is not and has not been any social class within our lifetime, at least in the Northern states, founded upon the vocation of farming or in any way related to it. We boast that we have no privileged classes in this country now. That is true, emphatically true, in the sense in which the word is used all over Europe where political and economical rights are often legally associated with different social classes.

But there is a sense in which classes form in every old human community, as there is everywhere in nature. The whole science of natural history and botany is founded on classification, and most scientific knowledge is classified knowledge. To study things scientifically we must classify them. So there is a sense in which there is a farming class, and discussing agricultural topics, we all of us rank them into classes. The bases of classification may be founded on different qualifications. We may classify them by the nature of their crops, or their land, or the scale on which they work, and so on, according to what we are studying, but this is not a social or political classification.

Now, from the very nature of the vocation there must be many in it who, from their personal characteristics, not from their occupation, will belong to a lower class socially. This, I repeat, will be because of the personality of the men themselves and not because they are farmers. Whatever their vocation may be, there are persons who will belong, socially, to a lower class, whether in the country or in the city.

Along with the changes going on in rural population, and more especially in the organizations of the farmers themselves, there are now many leaders or would-be leaders who want to train the farmers into an exclusive class, a class by themselves more than they have heretofore been in their social relations, in their culture, and even in their political action. They would have the farmers patronize each other in their business dealing because they are farmers and not because of better bargains, would educate their children so far as possible in exclusively farm schools, and so on. Nothing can be more unfortunate to the farmers themselves than this. The more completely this idea can be brought about, the nearer they will ultimately come

to be a peasantry. I have touched upon this matter more than once in previous addresses before this Board, and I still think that this is inevitable from the very nature of the vocation. It must be so. If the farmers insist on forming a class by themselves, that class will ultimately assume more and more the features of a peasantry socially (but not necessarily politically) in this country. The experience of other nations during many centuries point to this.

We have already many persons who begin to look at the small farmers in this country as peasants. I have heard within the last ten years several persons speak of the "peasantry of New England" and the "peasantry of New York" in the same sense and way that they would speak of the peasantry of France or the peasantry of Germany, and this term is beginning to creep into our magazine and newspaper literature in this sense. The guard against this must be with the farmers themselves. They must mingle with the men in other vocations all they can. Guard against the use of a dialect which the writers of fiction delight in portraying as belonging to country people. The Connecticut farmer must show that the language and ways of the best of other people are none too good for him, and, above all else, keep abreast of the times in matters relating to his own business.

I do not mean to say that we will ever have an actual peasantry in New England, but I do feel that we need to avoid the very semblance of it. Education, intelligence, business ability will keep the farmer in the same social and political level with men in other vocations.

In closing, I will say again that I consider there is a very hopeful prospect ahead for farming in Connecticut. Not that it will ever be conducted on the impressive scale common on the wide and easily-tilled prairies of the West, but I believe that capital and labor will now yield as much here as there. This has not been so in recent years, and more especially while the newer prairie lands were rising in value because of their increasing occupation and cultivation, and farmers there were growing richer, more from the rise in value of their land than by the production of crops. The pasturing of cattle and sheep on public lands, which the stockmen did not own nor pay for the use of, and which has worked so much against us in our competition, is being adjusted again, and I still believe that

New England is a more pleasant place for homes than the prairies of the West, however fertile they may be.

I cannot advise you what each farmer should grow or how to grow it to the most profit under the new agricultural conditions. I am no longer practiced in "The Art of Agriculture." I will not attempt to advise you in that. As to what to grow and how to grow it, each farmer must decide for himself from the experiences of his neighbors, the nature of his soil, his markets, and his own tastes and preferences.

Not the least hopeful sign is the breed of men still left on our farms. Under the new as well as the old I believe a man may still be reasonably successful and happy on a Connecticut farm, and still rejoice that he is a Connecticut farmer.

The PRESIDENT. The matter is open for discussion for a short time now. If there are any questions which you wish to ask we have the Question-box. What have you to say as to some of the suggestions and questions which have been offered this morning? Now, don't all speak at once, and don't get to talking so we cannot get to dinner, but if you have questions to ask, which come quick and pertinent, we will take them up.

If there are no questions, the secretary has some announcements to make.

Secretary Gold announced the speakers for the afternoon and evening sessions, and after music by the orchestra from The Connecticut Agricultural College, the convention adjourned until 2 P. M.

AFTERNOON SESSION.

Wednesday, December 13th.

Convention called to order at 2.30 P. M., Vice-President, Edwin G. Seeley, in the Chair.

The PRESIDENT. I think we better have some music to start with.

[Music by the Storrs' Orchestra.]

The PRESIDENT. I take great pleasure in introducing to this audience Prof. L. H. Bailey of Ithaca, N. Y., who will talk to us on "Some Facts and Fancies, Old or New, in Horticulture."

Prof. BAILEY. Mr. Chairman, Ladies, and Gentlemen:

I have been waiting patiently for Mr. Gold to tell me what I should speak about, for to speak upon some facts and fancies, old and new, in horticulture, includes almost everything relating to the care of plants. I am diffident in speaking before an audience in a country in which I do not know the local conditions of fruit-growing and agriculture, because specific remarks under such conditions might, perhaps, not apply to that particular district. Therefore, I shall content myself with speaking about the subject generally, and touching upon those features about which no one can contradict me. As I came on the train this morning it occurred to me, that in an old State like Connecticut, some horticultural reminiscences might be interesting, and as I notice you have nothing upon your program commemorative of Washington, of this anniversary of Washington's death, it occurred to me that I might say something about Washington as a farmer.

We ordinarily think of Washington the statesman, or Washington the soldier, but we should also think of him as a farmer. It is a strange fact that although volumes have been written concerning him, yet comparatively little is known about him as a personality, and about his private individual life.

In all the vast correspondence which has come down to us, there is but very little that reflects the man himself. He had the capability in his writings of hiding himself. Washington was born on a farm, and lived on a farm a large part of his life, and died on a farm. The farm which he came into possession of through the death of his elder brother, or half-brother, was an estate upon the banks of the Potomac, which measured eight thousand acres, and at the time of his death, 3,200 acres of this land were under a system of rotation of crops, or were being improved at that time. He lived from 1732 to 1799. At that time there was no scientific agriculture in the sense in which we understand it in these days. In fact, it was not until a few years after Washington was born that there came into the new world what was really the first fundamental idea in good farming, the reason for the necessity of tillage. It was in 1731 that

Tull prepared the first edition of his " Horse-Hoe Husbandry," which sets forth some of the reasons for tilling the soil. At that time the soil was not tilled as it is at the present time. In fact, it may be said that the soil was broken at that time for three particular things, — to enable us to get seed into the ground; to keep the weeds out of the land; to get crops out of the ground. Tillage, therefore, was necessary labor; but so far as known at that time there was little good in tillage for tillage's own sake. The first work on agriculture in North America was written by a Connecticut man in 1748, known as " Essays on Husbandry." It is now very rare. In that book reference is made to the new husbandry, by which was meant the work of Tull.

Tull had made a visit to Southern France, and there saw the good results of tillage, and, not understanding it, like a true philosopher set about to learn and explain. It was not known at that time what was the food of plants. Oxygen was not discovered. What makes plants grow? How do they take up the elements necessary for their life? Tull supposed that they took it up by particles, and the finer these particles, the more likely they were to get into the plant. The roots, therefore, must have mouths which take in the food. Tillage, therefore is the making of the land more fine so that the roots of the plants can take it up in small particles. That was the theory. Those were the reasons which Tull gave for the good results which he saw. The burning of the land, which nearly always gives good results, was said by Tull to give the results because the organic matter was reduced to such fine particles that the plants could take hold of it and take into their systems. Of course, we know that these were fancies; but one fact stands out clear, and that is, that Tull advocated tillage for tillage's sake, that tillage in itself is good. That was the beginning, I suppose, of the modern science of agriculture.

When Washington first began farming, all this was not generally known. It was a matter of dispute as to whether the effect of tillage was valuable for its own sake. There was no systematic rotation of crops. Let me read from Washington's diary: " The steady custom has been in the past to raise a crop of Indian corn, and then wheat; and then to let the land lay fallow; to let it rest eighteen months, and then to begin with Indian corn, then wheat, and then fallow or rest,

and then corn or wheat." This shows that the farmer practiced no adequate rotation of crops, and then allowed his land to lie fallow, or rest. On the question of yield, Washington says that towards the last part of the last century, the average yield on much of the good land was not more than 15 or 20 bushels to the acre. We complain even at the present day that agriculture is going backward, but it is a matter of fact that our average yield is larger to-day, under good farming, than it was at the beginning of the century. Strickland, an Englishman, visited Washington, and wrote in 1801 in reference to the agricultural conditions then existing, and his testimony is not pleasant reading. I may also cite you to Washington's famous correspondence with Arthur Young, as showing his interest in agricultural questions, and how thoroughly he was in touch with the conditions in his day. He says in one of these letters to Arthur Young, " The cultivation of tobacco has been almost the sole object with men of landed property, and consequently a regular course of crops has never been in view." Washington was one of the first to introduce rotation of crops. When he left his estate to take up arms in defense of the colonies, his land was in a fair state of cultivation. When he went back he found the place run down, but from the time of his presidency on he set about with his characteristic energy to recoup his losses, and bring the place back to its former state. Of course he had not manure enough for 4,000 acres of land, but he endeavored to profit by system. Red clover was a part of his system of rotation, and we find many references in his writings to that, and to Alfalfa, and to other like crops.

One of the things that puzzled Washington was the getting of a proper foreman for his place. He made a number of attempts, and finally, in 1793, he secured William Pierce, a man on the eastern shore of Chesapeake Bay. He seems to have been a very competent man, but like all competent labor, he came high. Pierce charged £500 for overseeing his place. Washington said that the price was too much, more than his estate could afford, but nevertheless, Pierce came with such good recommendations he was engaged. Pierce managed the estate from 1793 until 1796. At that time he was obliged to leave on account of rheumatism. Nearly every week during his presidency, or at least during his first incumbency of that office, Washington wrote to Pierce. He gave the most detailed

directions as to how he should manage this field, or that, or the other, and he was sending him new specimens of seed, potatoes, grains. In fact, to such an extent did he look for new things of this kind that it seems as though every man was importuned for seeds or for some knowledge of the agricultural conditions of the country whence he came. Let me read two or three extracts, showing how minutely he looked after and followed the agricultural operations on his farm. The extract that I now read was written at the very time when the troublesome " Jay treaty " was on his mind, one of the most troublesome things which he had to handle in his official career. He writes this: " Does the first sown buckwheat come up well? As fast as any field or lot is planted with potatoes let the quantity which has been used therefor be noted in the farm report of the place where they have been used. To plant the potatoes whole, is best, where there is enough of them; when there is not, cutting becomes necessary, and should then be adopted." He was very anxious about the hedges around his place. He saw that hedges and timber were important things to look after. He writes this to Pierce: " The thorn berries should be buried a year before they are sown in order that they may pass through a state of fermentation; unless they do this they will not come up. New Cedar berries shrould have all the casing of the seed rubbed off before they are sown, or they will not come up." Again he writes to Pierce in February, 1794: " Under cover with this letter you will receive, and I hope in good order, the White Bent grass seeds mentioned in my last letter, and half an ear of very early-ripening corn; the garden seeds written for by Eble; and four kinds of seeds sent me by a gentleman in England; some (or I believe all), of which came from the East Indies. In my last I gave directions covering the Bent Grass, and, therefore, shall say nothing about it here."

Washington's agricultural correspondence makes a book of several hundred pages, and all through it we find the minutest care in laying out and watching the work on that great estate. In spite of all the honors he had won on the battlefield, and as a statesman, he was proud of his work as a farmer. His heart was in it. He writes to Pierce in this way: " The more I am acquainted with agricultural affairs, the better I am pleased with them; in so much that I can nowhere find so great satis-

faction as in those innocent and useful pursuits. In indulging these feelings, I am led to reflect how much more delightful to an undebauched mind is the task of making improvements on the earth than all the vain glory which can be acquired from ravaging it by the most uninterrupted career of conquests." And this was the man who led the American forces to victory!

What was the condition of the farming population in those times? In the first place there were slaves, and there were white-indentured servants attached to the estates, the latter class, of course being above the former in standing. Above these, and dominating the whole country, was a class of country gentlemen, of which Washington was one. They did not work with their hands. Those who owned these vast estates of those days had immediately under them overseers. It was a sort of graded system. They hired overseers of this part of the estate and that part. Of this class of gentlemen, Washington was one of the chief representatives. These were the people who made the ideals of the time. They, with the clergy, dominated society and political life. Lawyers and physicians were not very high in the social scale. The latter part of the last century seems to have been a time of general awakening and organization, a general outlooking to new things and to progress. It was the time of the discovery of many of the elements of which the earth is composed; of oxygen, and other things. It was the time when some of the attempts in the breeding of domestic animals and plants began to be made.

It may be well, I think, in this connection, to make a brief survey of the conditions of agriculture in Washington's time as compared with the conditions at the present day. I should like to outline to you some of the common agricultural knowledge of to-day of which Washington was ignorant. I may repeat, in the first place, that Washington did not know why we tilled the soil. He knew nothing about the reasons why fertilizing the land inures to its benefit. In fact, he had no knowledge whatever of commercial fertilizers, for there were none. It is interesting to note how the country gentlemen of those days seemed to like to use large words and sonorous phrases for the common things about the farm. Dr. Rodgers, in 1750, wrote in a book in which he uses the word stercorary for a manure pile. This word he thought, perhaps was less odorous than that for which it stood. I find that even Washington uses the

word. He calls his manure-yard his stercorium. Washington knew comparatively little of drainage; yet, he did some underdraining on his farm, but it was apparently for the sole purposes of taking away standing water. He knew nothing about tile drainage. He knew nothing about a good mouldboard plow. He had an iron plow which was sent him by Arthur Young, and he regrets the fact, in his correspondence, that he was not able to get "new irons," after it got out of repair. He wrote to Young that since the irons were worn out, and there was no one in this country from whom he could obtain more, he had to throw the plow away. He knew nothing about farm machinery in the sense in which we do. He knew nothing from books of the principles of the breeding of animals, yet it is interesting to note that he tried experiments with different foods for fattening; and also successfully on sheep and mules. Let me quote from one of his letters to Pierce giving directions for carrying on a feeding experiment of that kind. He says: "I think it would be no unsatisfactory experiment to fat one bullock altogether with potatoes, another altogether with Indian meal, and a third with a mixture of both; keeping an exact account of the time they are fattening, and what is eaten of each, and of hay, by the different steers, that a judgment may be formed of the best and least expensive mode of stall-feeding beef for market, or for my own use." He did not know how plants got their food; whether from the earth or from the air. He did not know the cause of contagious diseases. He had no conception of germs. He did not know the life history of an insect, although we find him saying that the Hessian fly had become disseminated after the Revolution. He did not know the use of greenhouses as we know it. He knew nothing about the canning of fruits as we understand it. He knew nothing about commercial horticulture, because there was none. There was no commercial horticulture before the first third of this century. There was some seed business in New York and Philadelphia very early in the century, but that was for the supply of people who grow plants for their own domestic use. There were no agricultural schools, and there were no experiment stations at that time.

There were two things which Washington strongly recommended, and which to this day remain more or less unfulfilled.

Many of you know of one of these things, and that was a great national university. There is an agitation now for the establishment of a great national university at the national metropolis. Of course Washington could not foresee what the great growth of the states was to be, and how in every state there might arise great institutions of learning which would prevent our young men from going abroad to obtain their education. He said that our young men went to England and France and other countries and they became imbued with monarchial ideas thereby, and so became discontented with our republican institutions. The other thing which Washington urged very strongly, two or more times, was the establishment of a National Board of Agriculture. This, he said, would bring together and correlate all the knowledge of farming in the states, and make it available for use. Late in the century agricultural societies were formed, and in some cases these societies exist at the present day. I don't know as you are all aware of the great things these agricultural societies have accomplished. These societies, which to-day are represented by state boards of agriculture and other organizations, have been of the utmost benefit in the development of agriculture as a science. It was these very societies which originated and carried forward the agitation which resulted finally in the establishment of agricultural colleges. But it was not until the administration of President Harrison that this desire, so early expressed by Washington, for the recognition of agriculture, was finally accomplished, and the United States Commissioner of Agriculture was made a cabinet officer.

The condition of agriculture in Washington's time may be well illustrated if I read two extracts from his correspondence with Pierce, his overseer. It seems his gardener had failed to preserve some seeds which Washington was very solicitous to have maintained, and so he wrote a very pointed letter to Pierce, and says: "It is certainly a reflection upon a farmer to have his seeds to buy." And he writes to Pierce again, a year later, on the 8th of February, 1795: "It is shameful for gardeners and farmers to be buying seeds that their own soil and climate will produce after being once furnished." These remarks are, of course, not applicable to-day. To-day, we believe, that the best farmer is the man who does buy much or most of his seed, because there are people who make seed-raising and selling a

specialty, and who can do that business much better than a farmer. In Washington's time most of the seed had to be obtained in England and brought to this country in sailing ships, which were very slow, and there was no telling when they would leave, or when they would arrive, or whether they would arrive in time for the season's planting. Many times Washington speaks in his correspondence of his disappointment at seeds not arriving in time to be used that year, or the seed spoiling before the next. You can see how completely the whole condition or attitude of agriculture has changed from the two quotations which I have read.

Now, by way of comparison of the agriculture of that time with that of this, let us review a few advances. Since the death of Washington we have seen the complete rise of commercial horticulture; we have seen a change from the amateur to the commercial basis. Washington had very few peach trees, and very few apple trees. In all of his correspondence, in which he speaks often of his sheep and cattle, of his fences and crops, and many of the various departments of his farm work, he speaks rarely of fruits. He speaks often of his garden but rarely of his fruit trees. The raising of fruit received very little attention from the farming gentry of those days. John Tayler, writing early in this century, says that apples are a very good thing to have; they furnish excellent food for hogs, and they may be put in the cellar for family use also. He also speaks of the great use of apples for the making of cider. I am afraid that our ancestors thought of all fruit very much as Germans think of fruit; not as a thing to be eaten alone, but as a thing to be drunk. Our fruit raising has been run in the past partly on the old-world idea or standard — sacrificing everything to the variety and losing sight of tillage and other fundamental things. The first emphasis of fruit-books is on varieties. Commercial horticulture in America has progressed until we are the largest fruit-selling people in the world, and our people eat more fruit than any other people in temperate countries. Then the small fruit business has now found its place, and has assumed large proportions. A. S. Fuller's book on small fruits (1867), gave it a great impetus. His book, which has gone through three editions, has the honor of being the only American work on horticulture to be translated into German. It stood for a new industry. In vegetable garden-

ing we earlier caught the commercial spirit. The first book which really put this industry in its commercial aspect prominently before the individual was Henderson's " Gardening for Profit."

In cut flowers great advance has taken place. Fifty years ago there was almost no cut flower trade in the United States. The seed business began early, but in recent years there has been a wonderful development of this industry. In the early days there could be no extensive development, because the seedsmen and nurserymen knew that the farmer or gardener might grow the seeds and plants which he wanted for his domestic use. And that was very largely done except when seeds were brought from abroad.

Since Washington's time we have seen a wonderful change in the economic condition of the country. Since Washington's time we have seen the great flow from the country towards the city. We have seen the elevation of the cities within the last hundred years. There were no great cities in Washington's time. We are just now beginning to see a turn in the other direction. The people are beginning to go back to the country. We must look at this movement city-ward in a broad way, for there is nothing about it that should alarm us about the prospects of agriculture. It has not been a movement limited to our country. This is a world-wide movement. There is coming, if it has not already begun, an ebb of the tide. We see it in all of our work. We see evidence of the change in the evolution of the agricultural colleges, and of the experiment stations, which, as I said, are the outcome of the agitation of societies. These present days are days of science, of thinking, of searching for principles. The idea of the past generation was the idea of an attempt at scientific application. We now think in a scientific way. More than ever our time is a time of ideals. There is a constant shifting of ideals to higher planes. The farmer of Washington's time did not have an ideal before him so sharply defined or fixed as does the farmer at the present day. There were few ideals of the breeding of animals. There were no ideals as now in the breeding of plants. There should be a definite thing before the minds of men, an ideal, to be worked out, and then there is progress. If the farmer has no ideal, is he a good farmer? Even if he does not make anything out of his farm the farmer who has an ideal to be worked

out and realized gets joy out of his business. The farmer who has an ideal is always hewing to the line. It is an essential thing in tilling, as in anything else. You will find that in every horticultural operation. Have an ideal. In these days, education should teach us to think why, and then what. People are asking what the agricultural college and the experiment station have done in the way of help to the farmer. We know that we can point out a dozen things, and sometimes thirteen. But after all, it is not the particular application of science to the farm which is the big thing. The big thing is the point of view. You know how it is that farmers have turned their faces to the east in this last generation; how it is that there has been such a general intellectual rise in every part of our agricultural communities. The whole agricultural tone has been raised through these agencies. People are taking broader views of things and of life. Even if we did not have a single fact with which we could answer these people, it is a sufficient answer to say that every agricultural college and every agricultural experiment station, with all their faults, has been a strong factor in the general elevation of agriculture and the common good. The whole attitude is changed. You know that the farmers go to meeting to-day and talk about things which the professors could not talk about fifty years ago. It is the scientific habit of thought and no longer the mere extraneous application of science. And this leads me to say in closing that there is in the country to-day a movement towards nature-study. I believe in nature-study; but a great deal of the present movement under that name is not nature-study. What is nature-study? It is the opening of a man's mind to the conditions in which he lives; putting him into sympathy with everything that is. It is not so much the cramming of the mind full of knowledge as it is giving a man desire for knowledge. It gives him new feelings towards the conditions in which he lives; a new horizon. Give one a point of sympathy with nature and he will love it. It should be something to widen and broaden our view. It puts him in harmony with everything that is. If there is anything that will kill off this old idea of the mere application of elementary science it will be this. The larger part of the community never can go to college. As the generations come, more and more of the people will go to college,

but at the present day I would not have everyone go to college; but everyone can have a point of sympathy with nature.

The PRESIDENT. I would like to ask what kind of practical application he would make of this last principle to which he alluded relative to boys and girls starting in the world and making a living?

Prof. BAILEY. Well, that is a long question. I think that most farmers can make a living now. But what our farmers need, is not so much to know how to make more money as to know how to live. I should put it on that basis.

The PRESIDENT. That is a short answer. I will ask another question. I have been out in the State of New York considerably during the last six months among people who are trying hard to get a living, and are having hard work at it. They are the men and women engaged in the dairy business. They are trying to make milk for the New York market, and they are trying to make butter and cheese for any market they can find. For the last three years they have been getting no money from their farms. We have tried to make an investigation of the matter and find out where the trouble was, and we found that the people, on an average, had not received one single dollar more than it had cost them to produce and market their products of the dairies, to say nothing of their labor, or interest on the capital put into the plants which they have. That is not encouraging. That is the case in some portions of the State of New York; portions, as the professor probably knows, of Broome and Chenango counties. He will understand that they have been driven to organize and so take into their own hands the matter of marketing their products in some way or other so as to get a living out of it. Now, if we are going to have these very fine theories of putting ourselves in harmony with nature and the world around us, we somehow must have clothes on our backs, and we must have shoes on our feet, and we, somehow, must have the direct point so as to get into

sympathy with nature. Boys and girls don't like to stay on the farms if they have not got a pair of new shoes, and they are bare-footed. I only ask this question to know how we are to go to work to make this beautiful theory practical? I know the farmers are making a living for the most part; they are doing it by co-operation and by organization, and, somehow, they get to understand their environment and the situation of things around them. They are going to do it, sure as the world, but I didn't know but the professor could put us on to some point whereby we could come to a sort of understanding. That is the way, according to my idea, in which we are going to be brought into sympathy with nature, but we want something to hold the boys and girls on these hills, but they are not the place to make them feel that they are nature's true noblemen and women when they are crying out for the necessaries of life. Now, won't the professor give us what his ideas are on that?

Prof. BAILEY. In answer to that I would say, in the first place, this will not, in any degree, make them the less happy, and it will tend to make life on the farms much more agreeable. In the second place, I think that nine-tenths of those who stay on the farms are influenced to live on the farm by other than money considerations. I think that the child's first attention is fixed upon farm life as a desirable thing, and when manhood and womanhood is reached, stay there, not because of the prospect of making money, but because the life is better; because it gets enjoyment therefrom. I believe that is the starting point. I believe that as a child's mind is bent towards nature, it is more receptive for all of the practical applications of farming than it otherwise would have been.

Now, I am able to say but little about those conditions of which you speak in some of the counties in New York State. I have been in those counties, and I know that the farmers are having a hard time of it. There is no denying that fact. There are in the town of Ithaca, in which I live,

a number of merchants who are undergoing considerable stress on account of the dull times through which we have passed. Some of those merchants have failed. Those who have been wise, seeing the stress coming on, have gone into some other business. Now, I am wondering if a farmer should stay in a business in which he cannot make enough to support his family? There are two or three questions to be considered. Perhaps he can lessen the cost of production and thereby add to his profit; perhaps by combination he can lessen the cost of transportation and lessen the profits of middlemen, and thereby increase his own profit, but if he fails to accomplish that end by any or all of these, then stop. That is all there is to it.

Mr. PLATT. Where a gardener has changed the habit of a flower from the habit of looking down to the habit of looking up, I suppose that is done by selection; but I would like to ask, if the professor can tell us, how it was done otherwise than by selection? And also, in the same line, how much can we gain by selection of trees in the growing of fruit, or by the selection of seed in fruit? For instance, Governor Lounsbury told us about ten trees of Northern Spy apples on his father's place in his boyhood days, and one of them bore apples better in color, and in keeping qualities, and in flavor, than the other nine. I don't know as anybody knows what made it do so, but could that property or faculty be inherited by the graft?

Prof. BAILEY: There are two or three questions to consider. Possibly it might have acted as a law unto itself, but the principles which apply in that case, or which apply to one line apply to another in an equal degree, but, of course, fundamentally, there was some difference.

Now, as to the flower, of course, in the first place it was grown from the seed, and bred from those which were sown. Among those seedlings which came up there were differences, and some of them looked up more than others. Those were selected out, and then still another species of the same genus was brought in and bred with it. Crossed it with seedlings,

and after a while a third was crossed. I do not remember as to whether or not there were more than three, but, anyway, three species were introduced to make this type, and then it was bred by selection to the ideal type. In breeding, whether of animals or plants, the first principle is to get a variation, or a type to follow, and the result, of course, is different variations of that type, especially in plants, and there you have varieties. After the true, or ideal type is selected, then it is bred up by selection. There is always a great tendency in breeding to an ideal, especially in plants, to return. If you go into a patch and look you will find that a large percentage are all the time returning. The longer they are bred the less this tendency to return, and the greater the tendency or bent to breed true to the type.

Now, as to the Northern Spy. I suppose the tendency is all along the line for a tree to produce more or less its own characteristics or individualities. Every tree has characteristics of its own, and I fancy it is true to say, in general, that the more marked the characteristic is the more it will tend to perpetuate that characteristic. Whether any individual tree will, as a matter of fact, transmit its characteristics, we can only tell by experiment. I should certainly select scions from trees which had the characteristics which I wanted to perpetuate. If I had ten Northern Spy trees, and one of them was superior to the rest, I should certainly select scions from that tree which pleased me the best. We know it is true that a gardener will take a cutting which has certain blooming characteristics and perpetuate them, and why don't that same thing obtain in trees? We don't notice it so much because the generations are so long that they do not come under our observation. I do believe that a tree which has a strongly-marked characteristic will tend to perpetuate it.

Mr. HADWEN. In relation to the question which the Governor asked this morning as to the difference in this Northern Spy tree, it seems to me that the difference must grow largely

out of the seedling stock itself. These trees were, probably, grafted upon seedling stock, and it is probable that there was some difference between the stock in order to produce this fruit which was so much better. Still, there might have been other conditions that affected it. We do not know anything of the conditions of the soil underlying that tree. It might have been entirely different from that of the other nine, and we all know that apple trees that are well cared for or well fertilized produce better fruit than their neighbors.

I have been pleased with the lecture concerning Washington's early farming and the progress which has been made since then. Every one who has visited Mt. Vernon knows that it is a beautiful spot, and finely embellished with natural and ornamental trees. Some years ago I was there and they pointed out to me a Magnolia grandiflora that Washington planted himself the last year of his life. I got some young trees there and tried to grow them in Massachusetts. Of course I knew that the climate was too severe for that kind of a Magnolia, and I would take it and put it under cover in the winter, and put it out in the summer. I kept it several years, but finally lost it, as that kind did not appear to be hardy in this climate, although I have some fourteen or fifteen kinds that have proved to be hardy. There is a little story comes to my mind in that connection that I would like to relate. George Sumner, the brother of the Senator, went to Russia, and called upon the American Minister and desired an introduction to the Emperor. The minister informed him that it was quite a difficult matter for a private individual to be presented, but finally the minister promised to write to the Emperor and see if an audience could be brought about. In a few days Sumner received a note informing him that the Emperor's carriage would be in front of his place at such a time. Mr. Sumner got into the carriage, was presented to the Emperor, and he told him that the reason why he desired to be presented to his majesty was that he wished to present him

with an acorn that he had gathered from Mt. Vernon, the home of Washington. The Emperor received it with a great deal of pleasure, and invited Mr. Sumner to plant the acorn with his own hands. In after years he sent some of the leaves which had grown upon the oak and presented them to Charles Sumner. So much for the poetry of agriculture. Afterwards, when Lord Coleridge visited this country he went down to Mt. Vernon with Senator Evarts and some distinguished gentlemen from Washington, and was looking over the place and admiring the scenery, etc., and finally he said to Senator Evarts, "They tell me that Washington was a great athlete; that he could throw a silver dollar across the Potomac. Could that have been true?" "Well," says Evarts, "it might have been, for a dollar went a great ways further in those days than it does now."

Now, Mr. Chairman, I have had a little experience in farming. I am one of the farmers of the old school. I worked my way along. I did not know very much when I started in, but I have learned something most every day. I have enjoyed my life, and enjoyed my farm. I took my farm when there were no buildings upon it. It had been used for many years for a pasture, and consequently I took it in its primitive condition. I have lived upon it for more than half a century, and made out to subsist in an economical way. I have planted upon that farm some twenty acres of orchard. I have upon the farm more than one hundred different kinds of ornamental trees that I planted myself. I have timber used in the construction of my buildings that I planted myself. I have furniture in my house made of trees of my own planting. I have a great many more that would be equal to furnishing lumber for any purpose for which lumber is used. Those are some of the little features of farming. I enjoy trees, and have purchased a great many; everything that I hear of that is new I try to get. I have found in my line of experience that trees soon acclimate themselves. Trees that were considered tender fifty years ago are now hardy, and need no protection, as I

find in my experience. I suppose they become acclimated. That is the only way I can explain it, or perhaps the seeds have been received from trees living further north than they were in the early times.

Prof. BREWER. There are two or three little horticultural matters connected with what Mr. Bailey has touched upon that I think might properly be brought out. I think that the cut-flower industry as an industry started in this country with the second visit of Dickens. When Dickens came over in the late sixties or early seventies I recollect that he made quite a display of his boutonniere flowers. There was a great deal of newspaper comment upon it. A great many papers took it up, and little boutonnieres began to be sold in the New York market. The next year the New York papers spoke about the growing love of flowers that had been introduced by Dickens. About this time, or, I should say a little later, just as this began to come on, Oscar Wilde commenced his noted tour in the eastern part of the country. His flowers were laughed at a great deal because of the size of some of them. I think that many of our fashionable people to-day think that he used exceedingly small ones compared to what some of them use now, but it was quite a joke. In one place where he lectured a number of college students took the front seats in the hall, each one of them with an enormous sunflower on his coat, and it was the rule among them that no sunflower was to be worn less than five inches across unless a larger size could not be obtained. It made a good deal of fun, but at the same time it turned everybody's attention to the use of flowers for personal decoration, and by women as well as men, and I think you will find that the common sale of flowers on the street really got its first start in this country in that way.

Another little matter was suggested by what was said about Washington. You know Washington was one of the mule breeders in the United States. He imported Jacks from Spain, and he also had one that was presented to him. Whether we

had mules in the country before or not I am not certain, but it is very certain that the raising of mules had its decided start with his recommendation and work.

There was another matter suggested itself to me. When I first began to meet with the farmers in this State I was exceedingly interested in the history of agriculture in the State, and at all of the earlier meetings I made it a point to interview all of the older men, and I used to talk with the older men regarding the implements and tools of the farm used during their boyhood, and it occurred to me to ask, "When did the cast-iron plow come into use? When were they first used in this State? When were buggies with steel springs introduced? How many of the four-wheeled vehicles had springs of any kind at the beginning of the century?" Now, in connection with that I got very much interested in the question of flowers, and I might say that I remember of hearing that our earlier prominent men — men like Jefferson — became exceedingly interested in the improvement of flowers. I think it is likely that Washington did. I think there are one or two allusions in his agricultural correspondence which was published a good many years ago on that matter. But Jefferson took hold of the matter. In using the cast-iron plow, the mouldboard of the plow had to be made of wood, and in this country red oak was the most commonly used for that purpose. Now, the twist of the timber in our climate was usually to the right, but our mouldboards twisted to the left, and usually formed the shoulder in the direction of a screw. You may have noticed on the seal of the Agricultural Department the mouldboard on the plow twists the wrong way. I can recollect of hearing the farmers tell of what a job it was to find a red oak tree with the grain of the wood twisted, as we say, in the direction of the left-hand screw, because that was the direction for the mouldboard. There was quite a little difference in the twist, and it was made a matter of great study. Thomas Jefferson wrote a treatise on "The Mathematics of the Mouldboard of the

Plow." He worked up quite a paper on what should be the correct form of the mouldboard to be drawn through the soil with least labor to the draught animals. I think he read it before some prominent society.

Now, one word further regarding this apple tree. We hear a great deal about the variation of plants. No two plants alike, and so on. I think that the probabilities are that the whole secret of this particular tree is that it was from some graft different from the other nine trees, and that it was a variation in that direction. Now, if you look for variations in trees you will find that there is a marvelous difference in them. If you look through a park which has been planted with trees, there you will find as marked a personality in trees as among those in a state of nature on the hillside. In every walk about you will find in a group of trees a number having the same characteristics, and another or others of the same species with different characteristics. I have seen this on the New Haven Green. I picked out quite early trees with certain characteristics, and I have kept notes upon them for more than thirty years. I think that every tree in the Green has a personality of its own regarding either its foliage, or shape of leaves, or the time that it comes into leaf, or the time that it sheds its leaves, or the colors of its foliage. There is one maple tree in particular that I have noticed every year for more than thirty years. It has never turned red in the fall, and it holds its foliage longer than any other. Now, as to the question whether those characteristics would be perpetuated, I have no doubt myself but that each and every one of those trees would carry out those characteristics if grafted on another tree of the same species. There is a certain elm there that always retains its leaves longer. Its leaves do not blow off until all the others are gone. You can detect a difference in color and variety on that tree. There are other trees on the Green, and each one has a personality of its own. If there is anything in heredity, or if there is anything in the transmission of kind, as we know there is, through

grafts and buds, there is no reason why these peculiarities should not be continued in trees the same as we know they are continued in smaller plants. We recognize the force of this more if we have kept any history of them. I believe that is the secret of this particular apple tree, and I am willing to speculate that if the Governor would take the grafts from this one tree and graft them on the nine others the next generation would show the same difference as the tree from which they were taken. Not necessarily to the same degree, but the same in kind.

Mr. HINMAN. I want to say one word as to this subject of grafting because it has been taken up in the papers to a certain extent. I have no doubt but what, as Prof. Brewer says, that one tree in the Governor's orchard had something different about it, and it must have been grafted into the tree, but if it be true that the stock affected the fruit where would we be? We go to the nursery and buy a young tree of a given variety and put it out. We may buy a hundred trees and put them out, and we will get the same apples from every tree except there may be something to make a change. Now, that one tree may have been taken from a scion different from the others.

On my place a few years ago my man set out some cherry trees. As a rule we cannot grow them down there in the Housatonic Valley, but my folks got twenty-five or thirty trees and set them out, and those trees that lived are about alike, except one. The tree is three times as big as the rest, and my successor on that farm, unless I survive the tree, will wonder why that tree is a big tree, while the rest are so much smaller. He will wonder what there is about it. I know what there is, because my man told me. We had a cow that was killed, and she was buried under that tree, and that tree is three or four times as big as the others. Those bones are there, and for years and years to come that tree will be away ahead, but the man that comes on my place next has got to be told that or he will wonder why that one tree of the thirty

or so there is so far ahead of all the rest. Those little things are what count. Now, if we knew it were true that the Governor's tree was different stock, we couldn't do anything about it. You can go to a nurseryman and say, "Here, I want to have you get me certain stock for the budding of trees." He can't do it. There is no possible way of getting the stock. He must take the stock as it comes up from the seed. I never saw Baldwins but what were Baldwins, and Northern Spies, Northern Spies, and Sweet Boughs, Sweet Boughs. I don't care what the stock is you graft with, it is bound to be Sweet Boughs if you graft Sweet Boughs, and that must be true or our whole system of grafting is wrong.

Now, as to peaches. When my folks buy a basket of peaches the pits go into the stove. I will not have put into the ground on my place a peach pit unless I know where it came from, and know that the stock is all right. I bought a few years ago some trees of our friend Hoyt, and I bought another lot in Hartford. One lot all died when they were about three years old, and of the other lot about two-thirds of them died when they were from three to five years old, and the others are alive and thriving now. That was eight or ten years ago. I can plant those peaches with absolute certainty that I will get a tree that the frosts will not kill, and the chances are ten to one that we will have all the peaches we want and all the care we take of them is to set them out. We have got more than we care anything about, but I can guarantee you that the frosts won't kill those trees, nor the Yellows. If they are let alone they will live as long as their owner does.

Mr. Platts. In the matter of heredity of quality and size — on my place we had a Greening apple tree which seemed to be a little better in a great many respects than any other greening tree which was there, or that I came across. I grafted from that tree in the nursery, so that finally all the Greening apple trees that I had were from that one strain, and so far as I can see, the product is like the original. So it looks as though the good qualities of size and flavor can be transmitted.

Now I want to ask Prof. Bailey if he can answer a question as to the heredity of what may be a disease, or something that I know very little about. I think it has got the name of "Sponge Rot." It's on apples. It's a little brown spot right under the skin. Can you tell us something about that? Whether it is inherited, or whether it is very persistent on some trees and not on others?

Prof. BAILEY. I would not say. My impression is that it is a local disease, and that it is not inherited. I think Dr. Sturgis can tell better about it here than I can.

Prof. STURGIS. I believe any disease of the kind, or called "Brown Spot," may be hereditary in some degree in the same way as consumption is hereditary. There is a consumption which is born with the person; there is a tendency on the part of some persons to have it on account of the tendency of the lung tissues to harbor germs of consumption. And so I suppose some varieties or individual trees may be more susceptible to the disease than others.

Prof. BAILEY. Well, as a matter of fact, Professor, what is your explanation of it?

Prof. STURGIS. The only explanation I have ever seen of it is that the skin is not permeable, and in a very damp season the fruit of the apple tree takes up more water than can be taken care of. It is a tiny spot on the apple which turns brown, and is about the size of the head of a pin.

Mr. PLATTS. They are about that size; from that to about an eighth of an inch in diameter.

An apple affected in that way is very bitter, and I am trying to find out whether the same trees which produce the same disease year after year will transmit it?

A MEMBER. That is a point I would like to ask about; whether or not that is true? I know of one tree which has persistently borne water-core apples for eight or ten years, and then stopped.

Prof. STURGIS. It is the same class of disease as water-core, although it is not the same thing.

Mr. PLATTS. It is quite a serious thing in Connecticut; that is, the sponge rot I am talking about. The Baldwin apple is badly infested with it, and it takes away half the value of some crops.

Secretary GOLD. I want to say a word about this matter of the Northern Spy that the Governor brought out. I have got some dozen or twenty planted in three different orchards, and they bear very different fruit. I think that it is the condition of the soil, and the opportunities for light and air that makes this difference in the quality of the fruit. I have only one tree that really suits me in producing a nice quality of Northern Spy, and that almost uniformly produces a first-rate apple of that variety. Some others have not produced a bushel of good fruit in ten years. The surface is all rough and uneven. Now this one good tree stands in a very favorable position as regards plenty of light and air, and the opportunity to spread its roots in good, well-manured soil, good strength and fertility, and which is reasonably well drained, an ideal position for an apple tree. The others stand in all degrees of inferior positions, but I believe if I were to undertake the job I could drain the soil around those bad trees, and fertilize it, so that I would get as good fruit from those trees as I now get from the other, but I have not the courage and disposition to undertake it.

Now about the tree having a different stock. I should agree to that if I had not observed that when ten trees come from a nursery, all of one kind, and ten trees grafted to another kind of apples, the planter observes the difference and can often tell the variety by looking at the roots alone. I think that Mr. Hoyt would say that he didn't need to do anything but look at the roots of certain apple trees to recognize them in comparison with any other. Now those are grafted on all kinds of stock, and by the time the tree leaves the nursery the roots are as different as the tops. It is so with plums. The root is changed very materially in the three years between the budding or grafting of the plum and the time that you

transplant it. So that I do not believe that the stock has so much effect upon the graft as the condition of the soil beneath the surface, the degree of drainage, and the general exposure.

Now, Mr. Hoyt, let us hear about the roots of stocks after they have been grafted three or four years.

Mr. HOYT. Mr. Chairman, before I touch upon the root question I would like to touch some other points in the discussion of this question. There are a great many theories to be presented, but there are but very few facts that we know of in relation to the matter that has been discussed. What I have to say will be from the standpoint of a nuseryman. It is our custom to raise our trees from the seedlings that we raise ourselves by sowing good apple seed. We have sown as many as ten bushels of seed in one season upon four or five acres of ground. It has been our custom when these seedlings have been taken up and put into the cellar in the fall to sort them over at our leisure during the winter preparatory to their setting out, and from that vast quantity, which would run anywhere from six hundred thousand to a million, we select out one hundred and fifty thousand, say, of the best of those seedlings, and you would be surprised to see the difference there is in those seedlings; in the size of them. They will run at two years of age from the size of a rye stalk up to half an inch in diameter, and all of the same age, planted in the same soil, and all fertilized. There are many of them that are strong at the start from some cause. I do not know whether it is constitutional or whether it is because there is more food where that particular tree stood. Now, when we put those out into the nursery rows where the soil is all alike apparently, and the seedlings nearly graded to a size, you bud upon them all Baldwins, or any of the strong-growing varieties, and you will get a tree up the first year or two six feet in height, while if you put in a Newtown Pippin, or any of the slower varieties in their growth, you will have a small tree, perhaps three or four feet in height. So it is evident that the top has as much influence upon the root as the root does upon the top. Each variety has its

own habit of growth just as any fruit tree has its habit of growth, and just as much as we animals have our habit of growth. It is as natural in the early part of its life for a Baldwin to grow nice, and straight, and handsome, as it is for a Devon or a Hereford, which makes a large animal and a fine animal. It is just as natural for a Newtown Pippin to make a small growth as it is for a Jersey, and you cannot change them by grafting them upon strong stock, but you can help it by strong breeding, and getting strong stock you can bring those poor-growing varieties up to a larger growth at two years old or three years. It is a fact that the stock influences the root. You may dig up the surface over a Rhode Island Greening, a Roxbury Russet, or a Baldwin, all grown in the same conditions, of the same age, the same stock, and you will see that difference.

Now, in relation to this Northern Spy. You understand that all varieties have those habits and they are alike. Each variety is alike in these habits. As to the Northern Spy which the Governor spoke of, in my opinion the change or difference there was in that apple was entirely due to the place where it stood, and the food it got. I do not believe that the stock has that influence on the long-keeping of that apple. It is entirely, in my view, the conditions which surrounded that tree. If we placed the same conditions around each of those Northern Spies they would be alike. I know there are some freaks in nature which cannot be explained. Mr. Perry bought one hundred quince trees and set them out, but there was one tree which produced a later and better quince, which he propagated and called the Champion, and the Champion quince, which is propagated to-day is what you might call a sport from the ordinary run of quinces, and that property, or faculty of being later and better, is carried all the way down through. It is larger and better fruit, and you cannot change it.

Now referring to what Prof. Brewer said about the habits of trees, my observation has been that a tree which grows healthy, is well fed, and grows vigorously, will not produce those red

leaves. The red leaves on the Sugar maple will appear on that tree which is unthrifty; one which has not made any growth to speak of. If the limbs get bruised or hurt in some way the leaves will become red earlier in the fall. In fact, a maple tree which is thrifty, which is well fed, has leaves which are darker, and the tree makes growth. You always see red leaves on a maple which is unthrifty.

Mr. HINMAN. I believe with Prof. Brewer in the individuality of trees. Some thirty odd years ago I set out some trees on my place, and no two of them produce leaves at the same time in the spring. There is a great difference between the latest trees and the earliest. In fact, one of the thriftiest is one of the latest to bring out its leaves. Now, these trees, in order to produce bright foliage require time to ripen the leaves. This year we had no color in our foliage because early frost hit the leaves before they had time to ripen. When a leaf ripens it colors. Some trees differ a little, but I believe that a tree may ripen its leaves, and give the most beautiful colors without being in any way diseased, or in any way unthrifty. Some of the thriftiest and nicest trees I have got are the most beautiful when their foliage turns, provided the frost does not hit them.

I am requested to ask Prof. Bailey what influence the application of potash to the soil has in bringing fruit to maturity; that is, what is the difference between an abundance of potash in the soil in the productiveness of the tree, and in the lack of it?

Prof. BAILEY. What influence potash has in making a tree hold its fruit? I do not know as I want to answer that question. I think, though, that generally an abundance of potash tends to make fruit hang on better. I have seen a number of illustrations of that, yet they were not experiments which were made under the care of a chemist, and there may have been other things brought to bear. But, generally, I suppose that the application of a liberal amount of potash will tend to produce that effect. I have seen two or three experiments of that sort which were made by farmers who were careful, which

tended to bear that out, but you cannot say they were conclusive.

A MEMBER. I would like to ask Prof. Bailey if there is any way of preventing water-core in certain varieties of fruit? Or, is that something which is likely to come one year and not another? Can you prevent it? Can it be prevented by Bordeaux Mixture?

Prof. BAILEY. I do not think it is due to any fungus. I do not think it can be. If I had an apple tree which bore water-core apples continuously I should graft it or get rid of it.

The PRESIDENT. I would say that in my experience I remember some young trees bearing some apples of that kind in my father's orchard. They were very thrifty, good trees, planted in rich soil, and bore finely every year. They always bore water-core apples. That continued for as many as ten years, perhaps. Perhaps not more than five years, and then the trouble began to subside, and the trees finally bore fine apples with no water-core about them. I supposed that the apples were worthless, but finally they proved to be good trees. There was no difference in treatment that I know of from other trees around them.

Mr. PLATTS. Can Prof. Bailey say what is "variegation" in plants? I suppose it is a kind of a disease, but I would like to know.

Prof. BAILEY. The term "variegation" is used differently in different connections. It is sometimes used to specify a diseased condition, or more particularly the "mottling" of varieties. It is used by other people to denote the mottling of colors which is not associated with disease. The mottling of the leaves, and the mottling of colors, — the probability is they are two entirely distinct classes, but the mottling of the leaves, I think, is not of the same category as the variegation of the leaves. What it is due to in every case I do not know.

Secretary GOLD. I have taken in two or three questions upon the subject of peaches. "Is any treatment effective in checking rot of peaches?"

Prof. BAILEY. I think spraying with Bordeaux Mixture has been found fairly effective, and then also it may be done by trimming and pruning. In some varieties and in some seasons I do not think it can be wholly prevented.

A MEMBER. When should the Bordeaux Mixture be applied?

Prof. BAILEY. They think in Delaware, if the disease appears very early, they should spray before the buds come out. We find in our place that we get about as good results by spraying when the peaches are beginning to set as before. I believe myself that the most practical thing is a good heavy thinning. Keep the fruit well apart. We had some experience with plums, and we found when we did not thin we were in trouble. Spraying after the plums have set is certainly a decided benefit.

Mr. HOYT. Does it not appear more in early varieties than in late?

Prof. BAILEY. Nearly always.

A MEMBER. Have you ever found it possible to spray plums in full foliage?

Prof. BAILEY. Oh, yes. We do it right along every year. We very often do it, especially with Japanese plums. We have done it several times this year. It is sometimes very helpful to spray when they are in full foliage.

Secretary GOLD. "What is the condition of the peach buds at the present time?"

Prof. BAILEY. They are all right, or were a short time ago.

Sec. GOLD. How far advanced are they?

Prof. BAILEY. I do not think they are much if any larger than they ought to be.

Sec. GOLD. How is it, Mr. Hale, in Connecticut?

Mr. HALE. The buds are somewhat swollen, but, Mr. Secretary, we have with us this afternoon a gentleman who knows more about horticulture than any man in America, or, perhaps, in the world, and I wish that the time might be de-

voted to getting something out of him, instead of asking me questions.

Mr. HOYT. I want to ask Prof. Bailey what effect he thinks this weather will have on the peach buds?

Prof. BAILEY. In reply to that I would say that even if the peach buds are somewhat swollen in the fall, if the weather comes on cold gradually it does not do any harm. I think it depends a good deal on the way the weather comes on later. We have measured some of the buds at our place, measured them in a warm place, or spot, and afterwards when a cold spell came on we found that they were more or less shriveled, but it has not appeared to hurt them. I remember the same result with buds which stood fourteen degrees of frost after they were swollen up; doubtless a little swelling fails to hurt them if the cold weather comes on gradually and not suddenly.

Mr. HALE. Do you think if the cold weather came on gradually they would contract to their normal condition, or so it would not hurt them? I mean after they have swollen as they have at times.

Prof. BAILEY. It would depend upon how much they were swollen. If they are very much swollen it will, of course, hurt them, and I should suppose if they are very much injured they never would go back. But they do go back some certainly. If much swollen they fill up with water, and in cold weather that is what does the damage.

Mr. HALE. Where do they get that to do this with?

Prof. BAILEY. They get it from the roots.

Sec. GOLD. "How can we tell whether our peach and apple orchards have enough potash or not?"

Prof. BAILEY. The only way is to try and see. I don't know of anybody that can tell without doing so.

Mr. HALE. There is a general impression that seedling trees are better than grafted ones that have been moved from place to place, and in that feeling, which has been coming on quite largely, some people seem to think that the seedling should be planted directly where the tree was to grow, and

that they would be longer lived, more vigorous, and hardier. I don't think it would pay for the trouble and bother.

Prof. BAILEY. I don't believe it will pay any man. It is more bother than it is worth. I always buy those stocks from a nurseryman when I can and bud them and graft them.

Mr. HALE. Another question. Here we are growing a good many apples, and in packing and in delivering the crop for shipment it has come to be of considerable commercial importance as to in what form the crop is put up. What kind of packages. What is your opinion about that? Will the barrel continue to be used?

Prof. BAILEY. Why, I think it will. My opinion is that the barrel will be used, or some package in barrel form will be used in shipping commercial lines of apples. I doubt whether we will continue to use the barrel for the better quality of apples. I hope the time will come, and I believe it will, when we must differentiate apple packages the same as a merchant differentiates his packages in which his goods are put up so as to make them attractive. We have not differentiated in packing. Of course that is all a question which is outside the ken of the professor.

Sec. GOLD. Speaking about the condition of fruit, and the necessity for the farmer to know what trees are the more hardy, haven't we got to look to the removal of our forests which furnished a protection against sweeping winds, and sudden changes of temperature more than to any other condition in fruit culture?

Prof. BAILEY. That may be some of it. Some of it is due to other causes, though. There are more borers now than twenty-five years ago. The Yellows are more scattered, but, of course, I do not know, as a matter of fact, whether Connecticut has more. Undoubtedly, the cutting away of the forests and the submitting of orchards to the bleakness of the wind is quite a factor. I doubt if that is the main thing, though.

Sec. GOLD. "What is your opinion of low-heading as compared with the ordinary heading of apple trees?"

Prof. BAILEY. I think the question of low-heading is a different question from what it was twenty-five years ago. Now we have appliances so we can till our soil with comparatively low heads. For myself I think it is largely a question of personal ideal of the man who has the thing in charge whether he wants low heads or high heads. You can get good results in either case. For myself I like a tree, a symmetrical tree, something like four feet and a half to five feet above the ground. With our modern tillage tools we can handle matters of that character very well. It is a different question from what it was when we did not have as good tools as we have now. Then, again, what you may call the health of the tree has to be considered. It has an effect upon the health of a tree whether it is low or high-headed as a rule. I think we have gone to the extreme in the low-heading of apple trees. I believe a medium length of trunk is an ideal one.

Convention adjourned until 8 P. M.

EVENING SESSION.

Wednesday, Dec. 13, 1899 — 8 P. M.

Mr. Edwin G. Seeley in the chair.

The PRESIDENT. I have one request to make of the audience, and that is that they will all be seated, and be very still, and when seated, we will have the pleasure of listening to a song by Mrs. Stimson of Storrs.

Song by Mrs. Stimson.

The PRESIDENT. The lecture upon our program for this evening is "The Value of Birds to the Commonwealth." It is to be an illustrated lecture by aid of the stereopticon, by Mr. Frank M. Chapman of the American Museum of Natural History of New York. I now have the pleasure of introducing him to you.

THE VALUE OF BIRDS TO THE COMMONWEALTH.

By Mr. Frank M. Chapman.

Mr. Chapman. Mr. Chairman, Ladies and Gentlemen: Let me thank you, in the first place, for the privilege of addressing you on this subject. It is not often that an ornithologist has the privilege of speaking directly to the persons for whom he is working, perhaps in another field, but still working with a common end in view. I wish it were possible for me to so plead the cause of the birds to-night, and to make so clear to you the value of birds to the commonwealth, that you would all become converted to the cause of ornithology. If the birds themselves could speak to you; if your eyes and ears and hearts could be opened to the songs of the birds; if you could understand their place in nature, and what they are doing for you day by day, I am sure you would need no one to speak for them, for surely no one could speak as the birds can speak themselves. Consider for a moment what the birds are doing for us in summer when the hum of insect life fills, and becomes almost an inherent part of the atmosphere.

In the air, swallows and swifts are coursing rapidly to and fro, ever in pursuit of the insects which constitute their sole food. When they retire, the nighthawks and whippoorwills will take up the chase, catching moths and other nocturnal insects which would escape day-flying birds. The flycatchers lie in wait, darting from ambush at passing prey, and with a suggestive click of the bill returning to their post. The warblers, light, active creatures, flutter about the terminal foliage, and, with almost the skill of a humming-bird, pick insects from leaf or blossom. The vireos patiently explore the under sides of leaves and odd nooks and corners to see that no skulker escapes. The woodpeckers, nuthatches, and creepers attend to the tree trunks and limbs, examining carefully each inch of bark for insects' eggs and larvæ, or excavating for the ants and borers they hear at work within. On the ground the hunt is continued by the thrushes, sparrows, and other birds who feed upon the innumerable forms of terrestrial insects. Few places in which insects exist are neglected; even

Note. — For the electrotypes illustrating this lecture we are indebted to the courtesy of the U. S. Dept. of Agriculture, F. E. L. Beal, B. S., Farmer's Bulletin, No. 54, "Some Common Birds, in Their Relation to Agriculture"; and A. K. Fisher, M.D., Year Book Dept. Agriculture, 1894, "Hawks and Owls as Related to the Farmer."

some species which pass their earlier stages or entire lives in the water are preyed upon by aquatic birds.

Birds digest their food so rapidly, that it is difficult to estimate from the contents of a bird's stomach at a given time how much it eats during the day. The stomach of a yellow-billed cuckoo, shot at six o'clock in the morning, contained the partially digested remains of forty-three tent caterpillars, but how many it would have eaten before night no one can say.

Mr. E. H. Forbush, Ornithologist of the Board of Agriculture of Massachusetts, states that the stomachs of four chickadees contained one thousand and twenty-eight eggs of the cankerworm. The stomachs of four other birds of the same species contained about six hundred eggs and one hundred and five female moths of the cankerworm. The average number of eggs found in twenty of these moths was one hundred and eighty-five; and as it is estimated that a chickadee may eat thirty female cankerworm moths per day during the twenty-five days which these moths crawl up trees, it follows that in this period each chickadee would destroy one hundred and thirty-eight thousand seven hundred and fifty eggs of this noxious insect.

Professor Forbes, Director of the Illinois State Laboratory of Natural History, found one hundred and seventy-five larvæ of *Bibio* — a fly, which, in the larval stage, feeds on the roots of grass — in the stomach of a single robin, and the intestine contained probably as many more.

The same authority, after estimating the bird population of Illinois at three individuals to the acre, states: "It is my opinion that about two-thirds of the food of birds consists of insects, and that this insect food will average, at the lowest reasonable estimate, twenty insects or insects' eggs per day for each individual of the two-thirds, giving a total for the year of 7,200 per acre, or about two hundred and fifty billions for the state.

"Estimates of the average number of insects per square yard give us, at the farthest, ten thousand per acre for our whole area. On the basis, if the operations of the birds were to be suspended, the rate of increase of these insect hosts would be accelerated by about seventy per cent; and their numbers, instead of remaining year by year at the present average figure, would be increased over two-thirds each year. Anyone familiar with geometrical ratios will understand the inevitable result.

In the second year we should find insects nearly three times as numerous as now, and in about twelve years, if this increase was not otherwise checked, we should have the whole state carpeted with insects, one to the square inch over our whole territory. I have so arranged this computation as to exclude the insolvable question of the relative value of the birds and



FIG. 1.—BARN SWALLOW.

predaceous or parasitic insects, unless we suppose that birds eat an undue proportion of beneficial species.

"Let us take another view of this matter. According to the computation of our first state entomologist, Mr. Walsh, the average damage done by insects in Illinois amounts to twenty million dollars a year. These are large figures, certainly; but when we find that this means only about fifty-six cents an acre, we begin to see their probability. At any rate, few intelligent farmers or gardeners would refuse an offer to insure com-

plete protection year after year, against insects of all sorts for twenty-five cents an acre per annum; and we will, therefore, place the damage at one-half the above amount — ten million dollars per annum.

"Supposing that, as a consequence of this investigation, we are able to take measures which shall result in the increase, by so much as one per cent., of the efficiency of birds as an

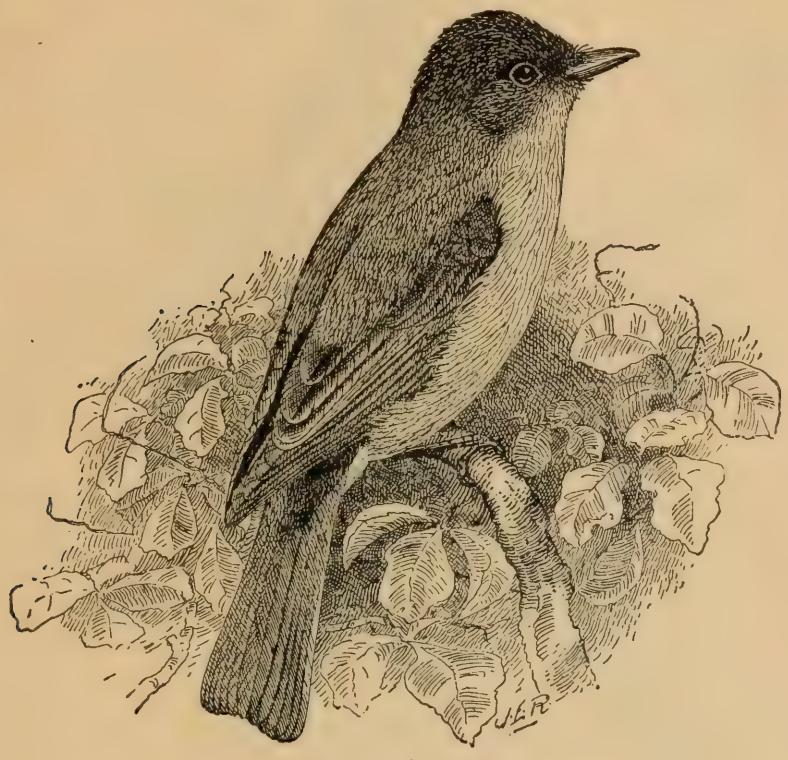


FIG. 2.— PHŒBE.

insect police, the effect would be a diminution of the above injury to the amount of sixty-six thousand dollars per annum, equivalent to the addition of over one and one-half million dollars to the permanent value of our property; or if, as in fact a most moderate estimate, we should succeed in increasing the efficiency of birds five per cent., we should, therefore, add eight and one-fourth million dollars to the permanent wealth of the state, provided, as before, that birds do not eat unduly of beneficial species."

This is a general view of the value of birds as destroyers of insects. Now let us go into the matter in some detail, and learn the more exactly the nature of the insectivorous food of our aërial, arboreal, and terrestrial birds. (As Mr. Chapman de-

scribed the different varieties, their pictures were thrown upon the screen, but only a few are figured here.)

At this point it should be remarked that we owe almost all our knowledge of the food of our birds to the investigations



FIG. 3.— KING BIRD.

of the Biological Survey, formerly the Division of Economic Ornithology and Mammalogy of the United States Department of Agriculture.

This division was established by the government in 1885, on the recommendation of the American Ornithologists' Union, and Dr. C. Hart Merriam was placed at its head. Under his efficient direction and with the assistance of Doctors Fisher, Palmer, and Judd, and Professors Beal, Barrows, and others, an amount of data has been accumulated which enables us to speak with certainty of the economic status of the birds whose food has been studied. It is to be the labors of the gentlemen whom I have mentioned, that I am chiefly indebted for the facts I am about to present to your consideration.

Beginning with the swallows, you will observe that the four species shown in this drawing differ markedly from one an-

other, and they may be readily recognized in size by the following prominent characters:

1. *Tail deeply forked, back glossy blue, breast brownish.* BARN SWALLOW.

2. *Back glossy greenish, breast pure white.* TREE SWALLOW.

3. *Forehead whitish, rump chestnut.* EAVE SWALLOW.

4. *Back dull brownish, a brownish band across the white breast.* BANK SWALLOW.

With the exception of the tree swallow which sometimes feeds on bayberries, these birds live wholly on insects, captur-



FIG. 4.— CEDAR BIRD.

ing winged ants, mosquitoes, and other insects, and they are, therefore, among our most valuable birds. The purple martin also belongs in this family, and in addition to its value as a destroyer of insects, is often of service in preventing the bird-killing hawks from raiding the poultry yard. The so-called chimney swallow, as a matter of fact, is not a swallow at all, but a swift, birds more closely related to the humming birds than they are to the swallow. So far as its feeding habits are concerned, however, it is to be classed among the destroyers of aërial insects, and renders fully as efficient services as the swallows themselves. When the swallows retire for the night, the

nighthawk and whippoorwill take up the chase, devouring insects, especially moths, which, in the caterpillar form, are so destructive to vegetation. These two birds are very often confused; we *hear* the whippoorwill, as, from a low perch near the ground, he utters his well-known call, and *see* the nighthawk coursing about high in the air overhead. As a matter of fact, they are not only quite different in appearance, but the nighthawk's notes are restricted to a nasal *peent*, and the loud booming sound made by the male in the nesting season, as with outstretched wings he swoops earthward.

Among the insect-eating birds, which, hawk-like, lie in wait for their prey, are to be mentioned the Phœbe, wood pewee, and kingbird. The Phœbe lives upon flies and wasps, May beetles, elm leaf beetles, squash beetles, caterpillars, grasshoppers, and grain and pea weevils, and its usefulness is generally recognized. The kingbird, however, is often not considered a beneficial species. It is supposed to kill bees, and for that reason has not secured the protection which, as a matter of fact, it is entitled to; it having been found, upon examination by the experts of the Department of Agriculture at Washington, that only fourteen out of two hundred and eighteen stomachs of kingbirds contained traces of honey bees, and most of these bees were drones, while ninety per cent. of the food of the bird consists of any injurious insects, such, for example, as the gadfly, the clover leaf weevil, and rosechafers; a single stomach containing not less than forty rosechafers and grasshoppers.

About the terminal branches of the trees we find the smaller insectivorous birds of the warbler family, of which there are between thirty and forty species in this State. These birds feed exclusively upon insects, their eggs and larvæ, and are universally admitted to be among our most useful as well as beautiful species. The vireos somewhat resemble the warblers in appearance, but are larger and have the bill slightly hooked. They are patient, persevering little creatures, and carefully examine the under surface of the leaves in search of the caterpillars which are feeding upon them. Five species of vireos are to be found in this State, the blue-headed vireo, with head ashy blue; the yellow-throated vireo, having the breast bright yellow and two white bars on the wings; the red-eyed vireo, having, as its name implies, a red iris, and the white-eyed vireo, which is also named from the color of its eye.

These birds feed upon caterpillars, as stated: the leaf-eating weevil, and also inch worms.

The cedar bird is supposed to devour large numbers of strawberries and cherries, indeed, is often called strawberry bird or cherry bird, and, it is true, the bird has a fondness for fruit. But this is one among many instances, where, for the acts of a few days, we condemn a bird for the entire year. As a matter of justice to the birds and in our own interests we



FIG. 5.—YELLOW-BILLED CUCKOO.

should not pass judgment on any species until we are thoroughly familiar with its habits. Doubtless you have all seen the cedar birds in the cherry trees and strawberry beds in June, but, do you know that in August these birds become fly-catchers, and that they also feed largely on caterpillars, spiders, and grasshoppers, and particularly on elm-leaf beetles.

Florence Merriam Bailey, whose book, "Birds of Village and Field," should be in the hands of everyone interested in economic ornithology, quotes Mrs. Mary Treat to the effect that in a certain town where the elms had been ruined for several years, the cedar birds appeared and the elms were afterward comparatively free from these destructive beetles. It has also been shown that thirty cedar birds would destroy 9,000 worms during the month when the cutworm caterpillar is exposed.

Cuckoos, of which we have two species, the yellow-billed and black-billed, are also great destroyers of caterpillars, and in Farmer's Bulletin No. 54 of the United States Department of Agriculture Professor Beal writes of them as follows:

"An examination of thirty-seven stomachs has shown that these cuckoos are much given to eating caterpillars, and, unlike most birds, do not reject those covered with hair. In fact, cuckoos eat so many hairy caterpillars that the hairs pierce the inner lining of the stomach and remain there, so that when the stomach is opened and turned inside out, it appears to be lined with a thin coating of fur.

"An examination of the stomachs of sixteen black-billed cuckoos, taken during the summer months, showed the remains of 328 caterpillars, eleven beetles, fifteen grasshoppers, sixty-three sawflies, three stink bugs, and four spiders. In all probability more individuals than these were represented, but their remains were too badly broken for recognition. Most of the caterpillars were hairy, and many of them belonged to a genus that lives in colonies and feeds on the leaves of trees, including the apple tree. One stomach was filled with larvæ of a caterpillar belonging to the same genus as the tent caterpillar, and possibly to that species. Other larvæ were those of large moths, for which the bird seems to have a special fondness. The beetles were for the most part click beetles and weevils, with a few May beetles, and some others. The sawflies were all found in two stomachs, one of which contained no less than sixty in the larval stage.

"Of the yellow-billed cuckoo, twenty-one stomachs (collected from May to October, inclusive), were examined. The contents consisted of 355 caterpillars, eighteen beetles, twenty-three grasshoppers, thirty-one sawflies, fourteen bugs, six flies, and twelve spiders. As in the case of the black-billed cuckoo, most of the caterpillars belonged to hairy species, and many of them were of large size. One stomach contained twelve American tent caterpillars; another 217 fall webworms. The beetles were distributed among several families, but all more or less harmful to agriculture. In the same stomach which contained the tent caterpillars were two Colorado potato beetles; in another were three goldsmith beetles and remains of several other large beetles; besides ordinary grasshoppers were several katydids and three crickets. The sawflies were in the larval stage, in which they resemble caterpillars so closely, that

they are commonly called false caterpillars by entomologists, and, perhaps, this likeness may be the reason the cuckoos eat them so freely. The bugs consisted of stink bugs and cicadas



FIG. 6.—HAIRY WOODPECKER.

or dogday harvest flies, with the single exception of one wheel bug, which was the only useful insect eaten, unless the spiders be counted as such."

Coming now to the insectivorous birds which feed on the trunks and limbs of trees, we have a group the members of which render peculiarly valuable services in devouring eggs and larvæ of many injurious species of insects. It includes the nuthatches, creepers, and woodpeckers; and it should be especially noted that most of these birds are with us throughout the year. Of woodpeckers Professor Beal remarks:

"Farmers are prone to look upon woodpeckers with suspicion. When the birds are seen scrambling over fruit trees and pecking at the bark, and fresh holes are found in the tree, it is concluded that they are doing harm. Careful observers, however, have noticed that, excepting a single species, these birds rarely leave any important mark on a healthy tree, but

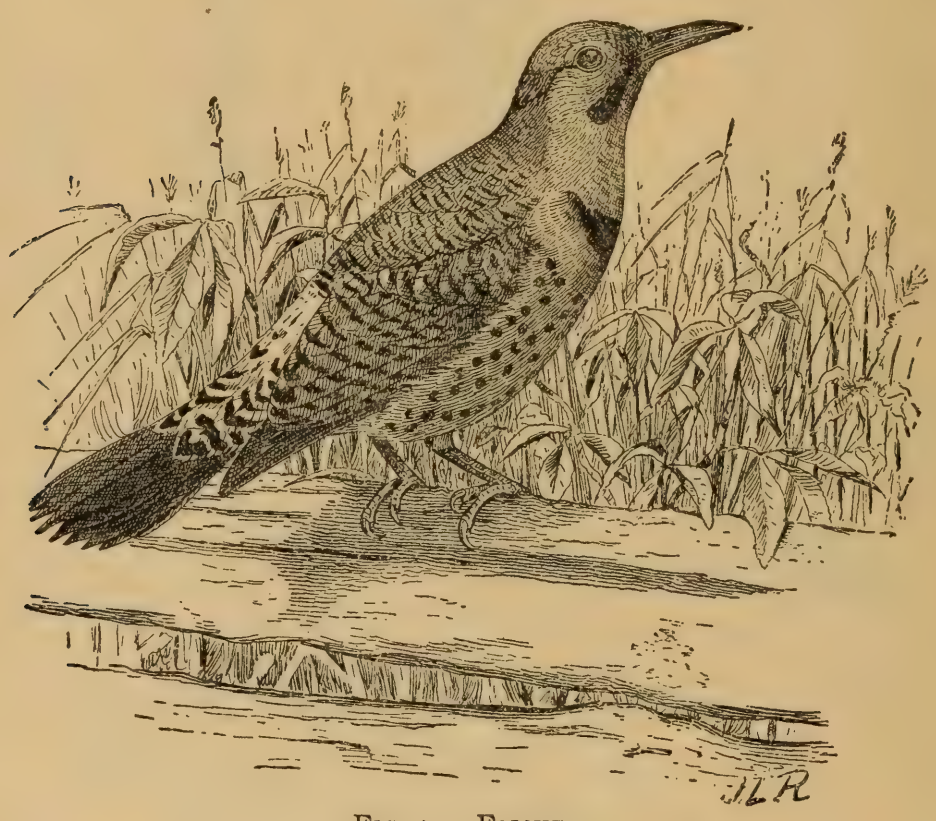


FIG. 7.— FLICKER.

that when a tree is affected by wood-boring larvæ, and insects are accurately located, dislodged, and devoured. In case the holes from which the borers are taken are afterwards occupied and enlarged by colonies of ants, these ants in turn are drawn out and eaten.

"Two of the best known woodpeckers, the hairy woodpecker (*Dryobates villosus*). . . and the downy woodpecker (*D. pubescens*), including their races, range over the greater part of the United States, and for the most part remain throughout the year in their usual haunts. They differ chiefly in size, for their colors are practically the same, and the males, like other woodpeckers, are distinguished by a scarlet patch on the head. An

examination of many stomachs of these two birds shows that from two-thirds to three-fourths of the food consists of insects, chiefly noxious. Wood-boring beetles, both adults and larvæ, are conspicuous, and with them are associated many caterpillars, mostly species that burrow into trees. Next in im-



FIG. 8.— RED-HEADED WOODPECKER.

portance are the ants that live in decaying wood, all of which are sought by woodpeckers and eaten in great quantities. Many ants are particularly harmful to timber, for if they find a small spot of decay in the vacant burrow of some wood-borer, they enlarge the hole, and, as their colony is always on the increase, continue to eat away the wood until the whole trunk is honeycombed. Moreover, these insects are not accessible to other birds, and could pursue their career of destruction un-

molested were it not that the woodpeckers, with beaks and tongues especially fitted for such work, dig out and devour them. It is thus evident that woodpeckers are great con-

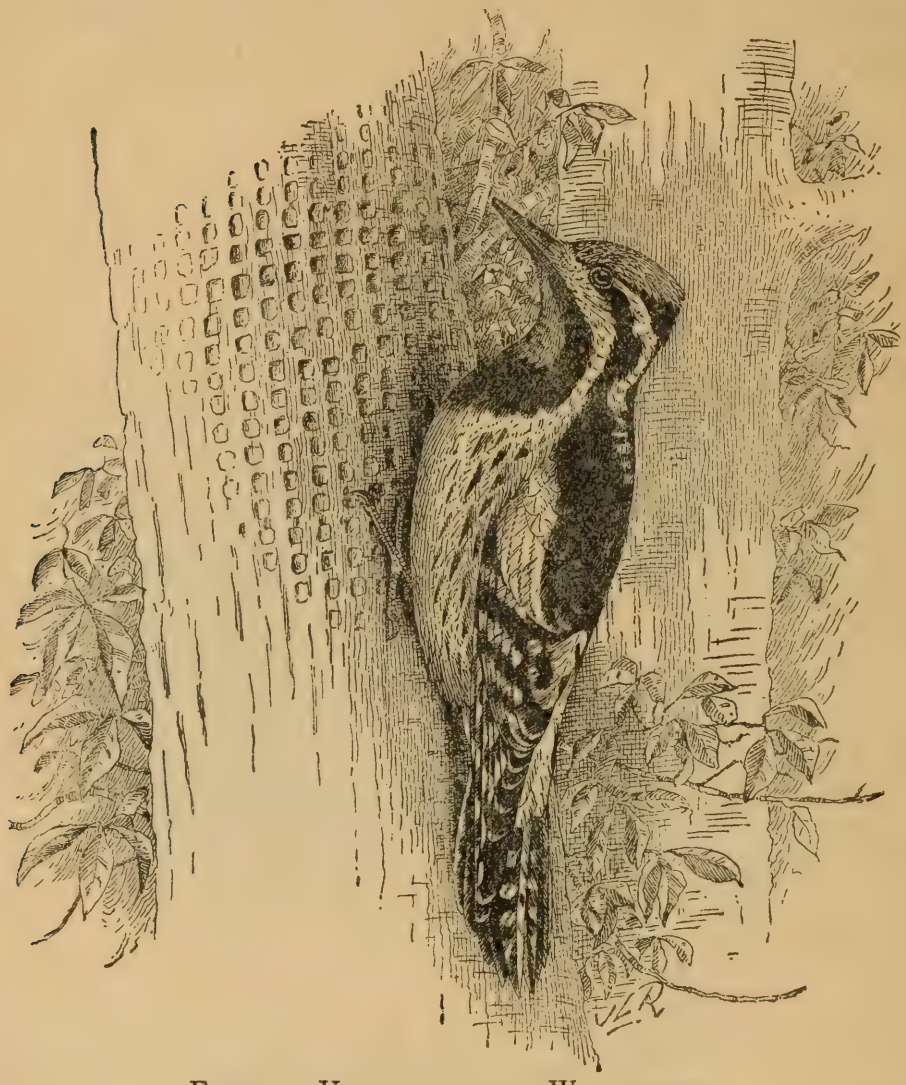


FIG. 9. — YELLOW-BELLIED WOODPECKER.

servators of forests. To them, more than to any other agency, we owe the preservation of timber from hordes of destructive insects.

"One of the larger woodpeckers familiar to everyone is the flicker, or golden-winged woodpecker (*Colaptes auratus*) . . . which is generally distributed throughout the United States from the Atlantic Coast to the Rocky Mountains. It is there replaced by the red-shafted flicker (*C. cafer*) which ex-

tends westward to the Pacific. The two species are as nearly identical in food habits as their environment will allow. The flickers, while genuine woodpeckers, differ somewhat in habits from the rest of the family, and are frequently seen upon the ground searching for food. Like the downy and hairy woodpeckers, they eat wood-boring grubs and ants, but the number of ants eaten is much greater. Two of the flickers' stomachs



FIG. 10.— BROWN THRASHER.

examined were completely filled with ants, each stomach containing more than 3,000 individuals. These ants belonged to species which live in the ground, and it is these insects for which the flicker is searching when running about in the grass, although some grasshoppers are also taken.

"The red-headed woodpecker (*Melanerpes erythrocephalus*) . . . is well known east of the Rocky Mountains, but is rather rare in New England. Unlike some other species, it prefers fence-posts and telegraph-poles to trees as a foraging ground. Its food, therefore, naturally differs from that of the preceding species, and consists largely of adult beetles and wasps, which it frequently captures on the wing, after the fashion of fly-catchers. Grasshoppers also form an important part of the food. The redhead has a peculiar habit of selecting very large beetles, as shown by the presence of fragments of several of

the largest species in the stomachs. Among the beetles were quite a number of predaceous ground beetles, and unfortunately some tiger beetles, which are useful insects. The redhead has been accused of robbing the nests of other birds; also of attacking young birds and poultry and pecking out their brains,



FIG. 11.— FIELD SPARROW.

but as the stomachs showed little evidence to substantiate this charge it is probable that the habit is rather exceptional.

"It has been customary to speak of the smaller woodpeckers as 'sapsuckers,' under the belief that they drill holes in the bark of trees for the purpose of drinking the sap and eating the inner bark. Close observation, however, has fixed this habit upon only one species, the yellow-bellied woodpecker, or sapsucker (*Sphyrapicus varius*) . . . The bird has been shown guilty of pecking holes in the bark of various forest trees, and sometimes in that of apple trees, from which it drinks the sap when the pit

becomes filled. It has been proved, however, that besides taking the sap the bird captures large numbers of insects which are attracted by the sweet fluid, and that these form a very considerable portion of its diet. In some cases the trees are injured by being thus punctured, and die in a year or two, but since comparatively few are touched the damage is not great. It is equally probable, moreover, that the bird fully compensates for this injury by the insects it consumes.

"The vegetable food of woodpeckers is varied, but consists largely of small fruits and berries. The downy and hairy woodpeckers eat such fruits as dogwood, Virginia creeper, and others, with the seeds of poison ivy, sumac, and a few other shrubs. The flicker also eats a great many small fruits and the seeds of a considerable number of shrubs and weeds. None of the three species is much given to eating cultivated fruits or crops.

"The redhead has been accused of eating the larger kinds of fruit, such as apples, and also of taking considerable corn. The stomach examinations show that to some extent these charges are substantiated, but that the habit is not prevalent enough to cause much damage. It is quite fond of mast, especially beechnuts, and when these nuts are plentiful the birds remain north all winter, instead of migrating as is their usual custom.

"Half the food of the sapsucker, aside from sap, consists of vegetable matter, largely berries of the kinds already mentioned, and also a quantity of the inner bark of trees, more of which is eaten by this species than by any other.

"Many other woodpeckers are found in America, but their food habits agree in the main with those just described. These birds are certainly the only agents which can successfully cope with certain insect enemies of the forests, and, to some extent, of fruit trees also. For this reason, if for no other, they should be protected in every possible way."

We have generally thought of birds in relation to agriculture as destroyers of insects, and it is only recently that economic ornithologists themselves have appreciated the incalculable service rendered by granivorous birds in eating the seeds of noxious weeds.

Aside from the elements, insects and weeds are certainly the chief enemies of agriculture, and if it can be shown that birds

are the chief enemies of weeds as well as of insects their economic importance surely must be admitted.

Writing of the harvest of weed seeds which in spite of the agriculturist's best efforts annually mature, Dr. Judd of the Biological Survey writes in his excellent paper on "Birds as Weed Destroyers":

SEED-EATING BIRDS.

"Fortunately certain agents are at work to check this harvest, and, perhaps, most efficient among them are seed-



FIG. 12.—CROW BLACKBIRD.

eating birds. Each fall and winter they flock in myriads to agricultural districts and live upon the ripened seeds of weeds. Since they attack weeds in the most critical stage of life, the seed period, it follows that their services must be of enormous practical value. The benefits are greatest in the case of hoed crops, since here are found the largest number of annual weeds, which, of course, are killed by frost and must depend for perpetuation solely upon seeds. The principal weeds which birds prevent from seeding are ragweed, pigeon grass, smartweed, bindweed, crab grass, lamb's-quarters, and pigweed. . . It is sometimes asserted that no thrifty farmer will allow these

noxious species to ripen seed, but such prevention is practically impossible, because even if all edges of fields and all waste ground could be cleared, weed patches along ditches, roads, and hedgerows would still remain to disseminate seed to cultivated land. It is in just these patches that birds congregate in greatest numbers.

"Some birds eat more or less weed seed throughout the year even when insects are most abundant. But their good work practically extends from early autumn until late spring, and is, perhaps, most noticeable in winter, when the ground is white with snow. During cold weather most of the birds about

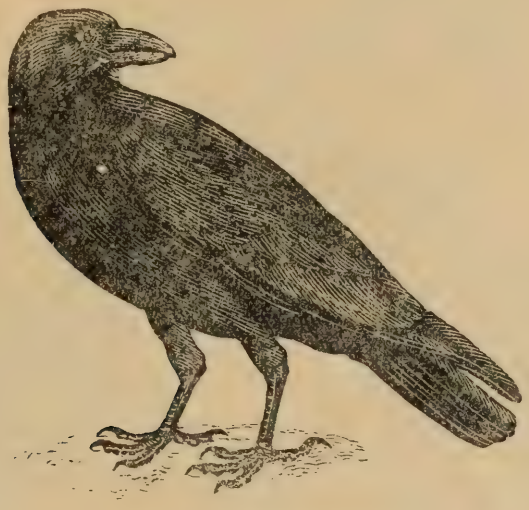


FIG. 13.— CROW.

the farm feed extensively upon seed, and gorge themselves until their stomachs and gullets become completely distended. It is not at all uncommon for a crow blackbird to eat from thirty to fifty seeds of smartweed or bindweed, or a field sparrow 100 seeds of crab grass at a single meal. In the stomach of Nuttall's sparrow were found 300 seeds of amaranth . . . and in another 300 seeds of lamb's-quarters; a tree sparrow had consumed 700 seeds of pigeon grass, while a snowflake from Shrewsbury, Mass., which had been breakfasting in a garden in February, had picked up 1,000 seeds of pigweed. The birds most actively engaged in consuming weed seed are sparrows and finches, including more than a score of species,*

*These species include the tree, song, field, chipping, grasshopper, fox, Nuttall's golden-crowned and white-throated sparrows, juncos, snowflakes, goldfinches, pine siskin, redpolls, towhees, and grossbeaks.

horned larks, blackbirds, cowbirds, meadow larks, doves, and quail."

From the seed-eating birds let us pass to a group of even more beneficial birds, which, strange enough, are more uniformly condemned and killed than any others. I refer to hawks and owls, birds which, as a rule, are not only not pro-



FIG. 14.— RED-WINGED BLACKBIRD.

tected by law, but in some states a reward is actually offered for their heads. Indeed, a law of this nature was recently passed by the Massachusetts legislature, and the history of the so-called "Scalp Act" in Pennsylvania furnishes a convincing illustration of the direct pecuniary loss which may follow ignorance of the economical value of birds. Quoting from the report for 1866 by Dr. C. Hart Merriam, Chief of the Biographical Survey of the Department of Agriculture: "On the 23d of June, 1885, the legislature of Pennsylvania passed an act known as the 'scalp act,' ostensibly 'for the benefit of agriculture,' which provides a bounty of fifty cents each on hawks, owls, weasels, and minks killed within the limits of the

state, and a fee of twenty cents to the notary or justice taking the affidavit.



FIG. 15.— RED TAIL HAWK.

"By virtue of this act about $90,000 has been paid in bounties during the year and a half that has elapsed since the law went into effect. This represents the destruction of at

least 128,571 of the above-mentioned animals, most of which were hawks and owls.

" Granting that 5,000 chickens are killed annually in Penn-



FIG. 16.— SPARROW HAWK.

sylvania by hawks and owls, and that they are worth twenty-five cents each (a liberal estimate in view of the fact that a large portion of them are killed when very young), the total loss would be $1,250, and the poultry killed in a year and a

half would be worth $1,875. Hence it appears that during the past eighteen months the state of Pennsylvania has expended $90,000 to save its farmers a loss of $1,875. But this estimate by no means represents the actual loss to the farmer and the taxpayer of the state. It is within bounds to say that in the



FIG. 17.—SWAINSON'S HAWK.

course of a year every hawk and owl destroys at least a thousand mice or their equivalent in insects, and that each mouse or its equivalent so destroyed would cause the farmer a loss of two cents per annum. Therefore, omitting all reference to the enormous increase in the numbers of these noxious animals when nature's means of holding them in check has been removed, the lowest possible estimate of the value to the farmer of each hawk, owl, and weasel would be $20 a year, or, $30 in a year and a half.

"Hence, in addition to the $90,000 actually expended by the state in destroying 128,571 of its benefactors, it has incurred a loss to its agricultural interests of at least $3,857,130, or a total loss of $3,947,130 in a year and a half, which is at the



FIG. 18.—COOPER'S HAWK.

rate of $2,631,420 per annum. In other words, the State has thrown away $2,105 for every dollar saved! And even this does not represent fairly the full loss, for the slaughter of such a vast number of predaceous birds and mammals is almost certain to be followed by a correspondingly enormous increase in the numbers of mice and insects formerly held in check by them, and it will take many years to restore the balance thus

blindly destroyed through ignorance of the economic relations of our common birds and mammals."

Why is it, then, that hawks and owls are held in such low repute by farmers, in fact by everyone, that to kill one is



FIG. 19.—GREAT HORNED OWL.

generally considered a meritorious act? It is another illustration of prejudiced and imperfect observation. Let a poultry raiser once see a hawk enter his yards and seize a hen, and from that time forth he is the enemy of *all* hawks, and never misses an opportunity to shoot at one. The fact that there may be a dozen or more different kinds of hawks in his neighborhood, and that most of them are of the utmost value, he is ignorant of; he does not discriminate; a hawk is a hawk, and in his opinion they should all be killed. We hold much the same views in

regard to snakes, and believe that because some species are venomous all species are.

It is unfortunate that the two species of hawks, Cooper's and the sharp-shinned, which, doubtless, kill over ninety per cent.



FIG. 20.—BARRED OWL.

of the poultry annually destroyed by hawks in this State, are sly, secretive species, who rarely soar or perch in exposed positions, and never scream as the mouse-hunting hawks do. They hide in the heart of a tree, slipping quietly to within striking distance, and then from their place of concealment dash into the poultry yard, and are soon off with their booty.

At the same time a red-shouldered or red-tailed hawk may be perched in some exposed situation near by, or screaming

loudly as he circles over head; or, perhaps, a marsh hawk is coursing patiently to and fro over the fields in his tireless search for mice. The farmer hears the commotion in the henyard, and, hurrying out with his gun, sees the innocent red-shoulder, red-tail, or marsh hawk, as the case may be, and with murder in his heart stalks them with the stealth of an Indian; and if,



FIG. 21. — BURROWING OWL.

perchance, he succeeds in killing one of the poor creatures, he nails its body in triumph to the barn door, a warning to future depredators.

One can almost imagine the real culprit chuckling to himself when he observes the farmer's self-deception, and misplaced satisfaction.

It was because of the widespread misunderstanding of the food habits of our hawks and owls, and because of their annual economic value, that one of the first acts of the Division of Economic Ornithology of the Department of Agriculture was to undertake a careful and elaborate study of the food of hawks and owls in order that their status might rest on the sound basis of observed facts.

This work was entrusted to Dr. A. K. Fisher, Assistant

Ornithologist of the Division, a naturalist of wide experience, who has won for himself a well-deserved reputation as a most careful and conscientious investigator.

After several years passed in accumulating material and in examining the contents of the stomachs of nearly 2,700 hawks and owls, Dr. Fisher concluded a volume of 200 pages in which are fully set forth the results of his studies. This volume forms Bulletin No. 3 of the Division of Ornithology and Mammalogy, and it is considered to be one of the most valuable contributions to economic zoölogy ever made.

From it we may learn the exact nature of the food of our so-called "hen" or chicken hawks, the red-shouldered hawk, and red-tailed hawk. The examination of the stomachs of 220 red-shouldered hawks gave the following result:

SUMMARY OF CONTENTS OF 220 STOMACHS OF THE RED-SHOULDERED HAWK.

3	stomachs	cont'd	poultry	92	stomachs	cont'd	insects
12	"	"	other birds	16	"	"	spiders
102	"	"	mice	7	"	"	crawfish
40	"	"	other mammals	1	"	"	earth worms
				2	"	"	offal
20	"	"	reptiles	3	"	"	fish
39	"	"	batrachians	14	"	were	empty

SUMMARY OF THE CONTENTS OF 562 STOMACHS OF THE RED-TAILED HAWK.

54	stomachs	cont'd	poultry or game birds	47	stomachs	cont'd	insects
				8	"	"	crawfish
51	"	"	other birds	1	"	"	centipede
278	"	"	mice	13	"	"	offal
131	"	"	other mammals	37	"	"	batrachians or reptiles
				89	"	were	empty

The name "chicken hawk" is also applied to our broad-winged hawk, a somewhat smaller species than the two preceding, but closely related to them; but examination of 65 stomachs of this bird failed to show that one bird of the number had eaten poultry, the summary being as follows:

SUMMARY OF THE CONTENTS OF 65 STOMACHS OF THE BROAD-WINGED HAWK.

2	stomachs	cont'd	small birds	13	stomachs	cont'd	batrachians
15	"	"	mice	30	"	"	insects
13	"	"	other mammals	2	"	"	earth worms
				4	"	"	crawfish
11	"	"	reptiles	7	"	were	empty

It would appear, therefore, that this hawk is largely insectivorous, and when we study the food of our misnamed sparrow hawk, we find that it is a truly insectivorous bird, as

will be seen from the appended summary of the contents of 320 stomachs:

SUMMARY OF THE CONTENTS OF 320 STOMACHS OF THE SPARROW HAWK.

1	stomach	cont'd	a game bird	12	stomachs	cont'd	reptiles or batrachians
53	stomachs	"	other birds				
89	"	"	mice	215	"	"	insects
12	"	"	other mammals	29	"	"	spiders
				29	"	were	empty

A hawk frequently observed, because of its habits of hunting in the open, is the marsh hawk; we may know him by the white patch at the base of his tail, above which it shows conspicuously as he flies. This species is a mouser, as appears from the following summary of the contents of 124 stomachs:

SUMMARY OF THE CONTENTS OF 124 STOMACHS OF THE MARSH HAWK.

7	stomachs	cont'd	poultry or game birds	7	stomachs	cont'd	reptiles
34	"	"	other birds	14	"	"	insects
57	"	"	mice	1	"	"	indeterminate matter
22	"	"	other mammals	8	"	were	empty

Admitting the value of the hawks above mentioned, the question is, how is the farmer to distinguish them from the bird and hen-killing hawks, that is, Cooper's and the sharp-shinned? It is a difficult matter. However, if we remember that the red-tail has a high, piercing whistle, like the sound of escaping steam, and that the red-shoulder screams *kèe-yer, kee-yer*, as he soars in wide circles, we should be able to recognize the two species which most often pay the penalty for the sins of Cooper's and the sharp-shinned. The latter are slim hawks with proportionately longer tails than either the red-tail or red-shoulder, and are rarely heard calling or seen soaring.

But, perhaps, after all, the only safe way to give justice to whom justice is due is to kill only the hawks we actually see taking our chickens, and not murder indiscriminately every member of the hawk family.

Owls are even more beneficial than hawks, and because of their peculiar feeding habits the nature of their food has been ascertained more exactly.

Hawks, as we know, grasp their prey with their strong, well-armed feet and tear it to pieces with their bill; but owls swallow their food entire, and the digestive function collects or rolls into a pellet or compact wad the feathers, hair, and bones, which are afterwards disgorged. Often large numbers of these pellets may be found beneath the perches regularly fre-

quented by owls, and, on analysis, the food of the species becomes known. For instance, a pair of barn owls — the monkey-faced owls of the press — have lived for many years in one of the towers of the Smithsonian Institute at Washington. In their retreat no less than 675 pellets were collected, and these pellets were found to contain the remains of 1,730



FIG. 22.— ROSE-BREASTED GROSBEAK.

mice, of which 400 were of the common house mouse. Certainly here is a bird which every householder, as well as every agriculturist, should protect. Unfortunately it is southern in its distribution, and, although it has given some indication of an attempt to extend its range northward, it is so uniformly shot on sight that I fear this region is too thickly populated for it ever to attain a foothold here.

However, we have owls fully as deserving of protection as the barn owl; indeed, of the six species commonly found in Connecticut only one, the great horned owl, can be considered injurious, and as it always disappears as a region becomes thickly populated, its opportunities for destructiveness are limited. Let us then learn somewhat of the nature of the food of our more common species as it has been ascertained by Dr. Fisher.

Of the larger owls, doubtless, the barred is as common as

any. It is the species with black eyes, without ear-tufts or "horns," which calls in a deep-toned voice, whoo, whoo, whoo-whoo, too, whoo, too-whoo-ah. Dr. Fisher examined the contents of the stomachs of 109 individuals of this species with the following result:

SUMMARY OF THE CONTENTS OF 109 STOMACHS OF THE BARRED OWL.

5	stomachs	cont'd	poultry or game	1	stomach	cont'd	a lizard
13	"	"	other birds	2	stomachs	"	fish
46	"	"	mice	14	"	"	insects
18	"	"	other mammals	2	"	"	spiders
4	"	"	frogs	9	"	"	crawfish
				20	"	were	empty

The short-eared owl, which lives in our marshes, is a famous destroyer of meadow mice, as may be seen from the appended statement of Dr. Fisher:

SUMMARY OF THE CONTENTS OF THE STOMACHS OF 101 SHORT-EARED OWLS.

11	stomachs	cont'd	small birds	7	stomachs	cont'd	insects
77	"	"	mice	14	"	were	empty
7	"	"	other mammals				

Even this excellent record has been exceeded by the long-eared owl, the nature of whose food is shown in the following summary of Dr. Fisher's examinations:

SUMMARY OF THE CONTENTS OF 107 STOMACHS OF THE LONG-EARED OWL.

1	stomach	cont'd	a game-bird	5	stomachs	cont'd	other mammals
15	stomachs	"	other birds	1	"	"	insects
84	"	"	mice	15	"	were	empty

It has been shown that among our hawks some species feed so largely upon insects as to be classed among the insectivorous birds, and so among our owls we find that certain species subsist to a great extent upon insects. This will be evident on examination of the following summary of the food of our little screech owl as given by Dr. Fisher:

SUMMARY OF THE CONTENTS OF 255 STOMACHS OF THE SCREECH OWL.

1	stomach	cont'd	poultry	5	stomachs	cont'd	spiders
38	stomachs	cont'd	other birds	9	"	"	crawfish
91	"	"	mice	7	"	"	miscellaneous matter
11	"	"	other mammals				
2	"	"	lizards	2	"	"	scorpions
4	"	"	batrachians	2	"	"	earth worms
1	"	"	fish	43	"	were	empty
100	"	"	insects				

I trust that enough has been said to convince you of the value of these much maligned hawks and owls. It is, perhaps, too soon to expect our law-makers to pass measures protecting them, but we can at least prevent the enactment of laws setting a price on their heads, and in the meantime we hope that the

real status will eventually become generally known when they will undoubtedly be accorded the protection they deserve.

After speaking of birds whose services are so little appreciated, it is pleasure in calling your attention now to the part played by birds as scavengers, to cite one case where birds are so highly esteemed that they are not only protected by law, but they are also protected by a public sentiment so strong that the force of the laws is really not needed: I refer

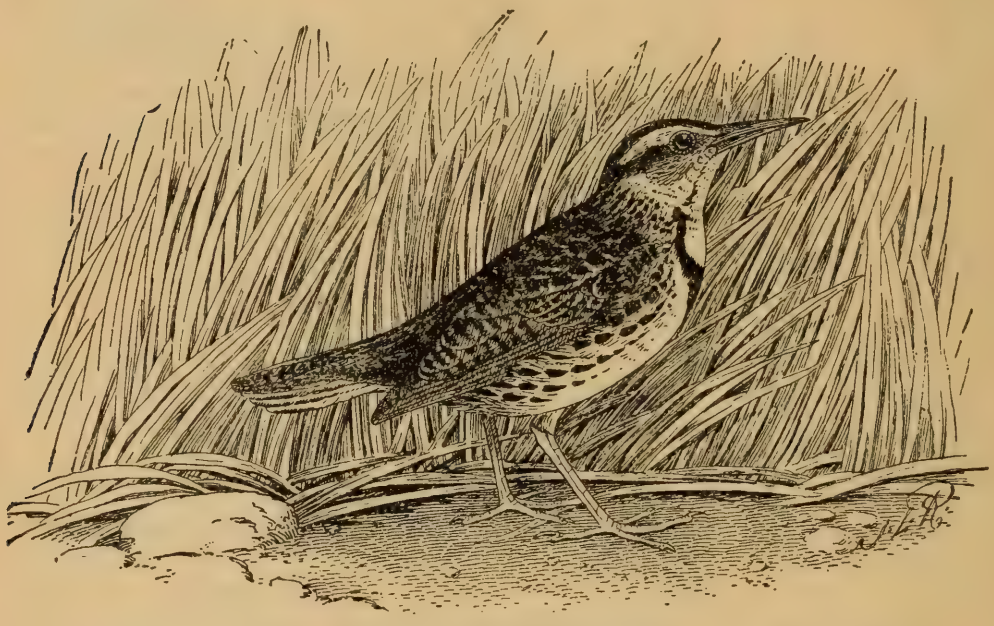


FIG. 23.—MEADOW LARK.

to the buzzards and vultures of our southern states and southward. The usefulness of these birds in supplementing the work of the generally inefficient street-cleaning departments of tropical cities; the assistance they render in devouring dead animals, is thoroughly realized, and, as a result of the protection accorded them, these birds have become not only very abundant but remarkably tame.

I sometimes wonder what would be the result if we should accord to other birds the same consideration we show the buzzards?

As an excellent illustration of the close relation existing between bird and man, let me call your attention to certain facts in the history of these buzzards and black vultures in the West Indies. Upon examination of the colored area of this map of the Western Hemisphere, you will observe that although these birds are found throughout our southern states, south-

ward through Mexico and Central America to Patagonia, they inhabit only two of the West India Islands, Cuba and Jamaica, and, so far as I can learn from histories of the voyages of the early explorers, these birds were not found in either Cuba or Jamaica at the time of the discovery of these islands by the Spaniards. As is well known both the buzzards and the vultures feed in nature on carrion, and, throughout their continental range, they, doubtless, subsist on the larger mammalia.



FIG. 24.—HOUSE WREN.

We know, however, that the West India Islands possess no large mammals, and the former absence of these birds from this region is, doubtless, to be attributed to lack of food. With the coming of the Spaniards, however, and the introduction of negroes into the West Indies, there followed conditions which resulted in furnishing buzzards and vultures with an abundant food supply. In Jamaica and Cuba the birds may be observed in numbers about the towns and villages, but not far from the habitation of man. It is with great interest, therefore, we learn that since General Wood has introduced an effective street-cleaning department in Santiago de Cuba, the buzzards, being deprived of their former food, have actually at-

tacked the cats and dogs in the street; and should General Wood succeed in introducing the same admirable sanitary measures throughout Cuba, we may witness in the near future a complete extinction of these scavenger birds in that island.

Now we have birds here which are equally valuable as scavengers, but their services are not recognized. They are not protected by the State, and they are being killed in large

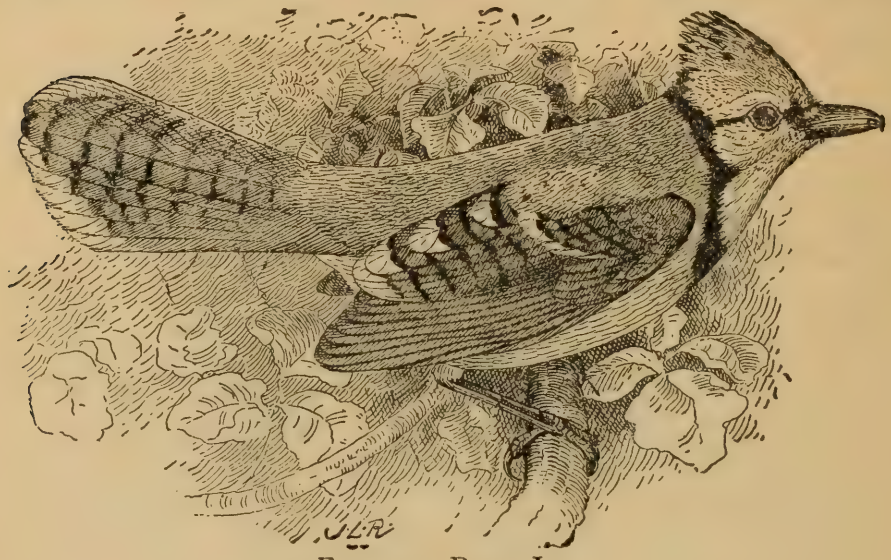


FIG. 25.— BLUE JAY.

numbers in consequence. They are the gulls that everyone who goes to the seashore sees circling out over the water. Perhaps you are familiar with these birds which are shown in the picture, and have seen them coursing to and fro over the waters in our harbors. They are only sea-gulls, and unless you are a lover of birds and of bird life, and rejoice in the beauty and the grace of these white-feathered creatures, you have no particular interest in them. I wish you had. At the present time, up and down this coast, from Maine to Mexico, bands of men are killing these sea-gulls to supply the insatiable demands of milliners for the ornamentation of our ladies' hats, and they say that the demand far exceeds the supply. These birds that are being shot on our coasts so wantonly have a great economic value. They are scavengers, just as the buzzards and the vultures in the south are scavengers.

I was very much impressed with this fact after making several trips into the lower part of New York harbor to photograph the gulls, which are attracted there by large quantities of garbage, which, at high tide, is deposited on the waters by dumping scows from the city.

In the picture upon the screen you see the host of gulls which are following in the wake of one of the dumping scows. There are eleven of them, and the wake of each scow is followed by a large host of these birds. When one sees this immense flock all bent upon picking up this waste material, and at the same time realizes that throughout the length of our coast line and on many of the lakes of the interior these birds are rendering efficient service in the economics of nature, then one appreciates the importance of properly protecting them.

An American physician whom I met some years ago in Yucatan, a close student of nature, was alive to the value of shore-inhabiting birds in the tropics, and he stated that in his opinion the recent increase in human mortality in the coast region of Yucatan may be attributed to the destruction of



FIG. 26.— BALTIMORE ORIOLE.

littoral birds which have been killed in immense numbers for millinery purposes. So much for the work of birds as scavengers.

Now, what are we going to do about it? If I have convinced you that birds deserve our protection, shall we remain inactive, or shall we take some steps in the matter? Shall we

not only cease to kill birds, but also adopt some means which will result in making the world more inhabitable for them, and, consequently, increase their numbers? You will all remember that when the English sparrow was brought to this country it was nourished and cared for most carefully. In fact, in Prospect Park, Brooklyn, where a certain number of pairs of sparrows were liberated, a keeper was appointed, whose duty it was to see that the birds were fed and nourished.

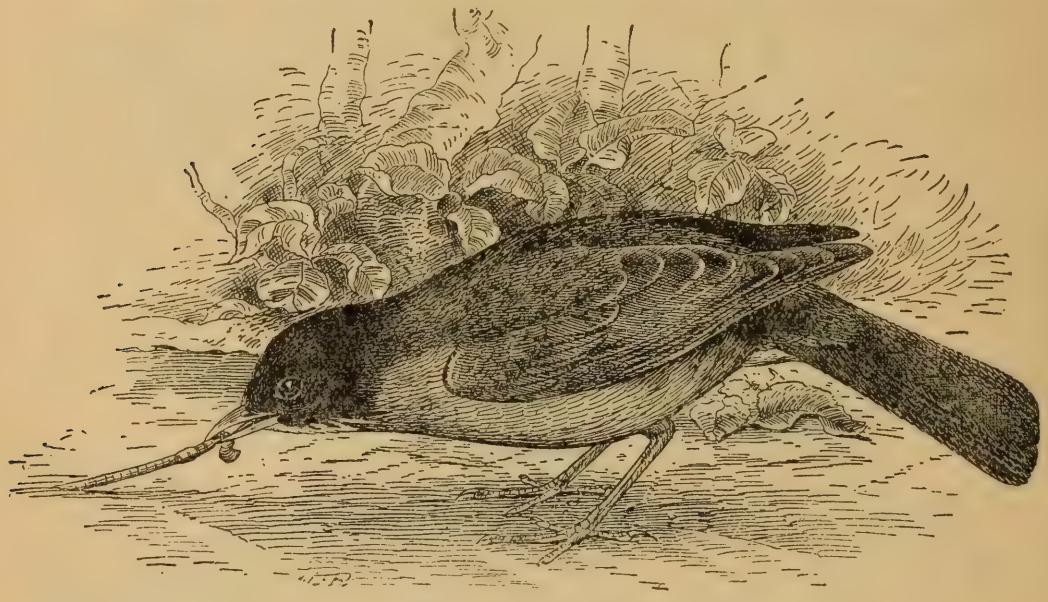


FIG. 27.— ROBIN.

Did any one hear of a keeper being appointed to protect American birds? Wherever these sparrows were put out they have flourished, and are now generally distributed throughout this country. It is a common thing to see boxes put up for them; but how often, in comparison, do we see homes erected for our own song birds?

Now, the first thing to do, if we desire to protect our birds, is, to secure the enactment of proper laws. Such laws must be aimed not only at the killer of the bird but at its seller. Sportsmen have learned that game-laws which permit only the prosecution of the killer are practically worthless. Here and there we may be able to catch some transgressor in the act, but an army of game wardens would be required to properly enforce such laws.

What is needed is a law which accepts as evidence not only the bird itself but the bird's feathers or indeed any part of a bird. It should be illegal not only to kill birds but to sell

them or their plumage. When such a law is enacted the great destruction of bird-life for millinery purposes may be stopped.

But we should take more than negative measures to protect our birds. The State appoints *game* wardens and *game* commissioners, but did any one ever hear of its appointing guardians especially for the song and insectivorous birds?

Laws are not self-acting. The game laws would be useless



FIG. 28.—CATBIRD.

if sportsmen were not active in securing their enforcement. But until the Audubon Societies were established there was no organized movement designed especially to care for non-game birds.

May I venture to hope that what has been said to you this evening has sufficiently convinced you of the value rendered your interests by your feathered allies that you will be glad to co-operate with those who have at heart the welfare of the birds.

LIST OF SOME CONTRIBUTIONS TO ECONOMIC ORNITHOLOGY.

Notes on the Nature of the Food of the Birds of Nebraska, by S. Aughey; First Annual Report of the United States Entomological Commission for the Year 1877, Appendix ii, pp. 13-62. The Food of Birds, by S. A. Forbes; Bulletin No. 3, Illinois State Laboratory of Natural History, 1880, pp. 80-148. The Regulative Action of Birds upon Insect Oscillations, by S. A. Forbes, *ibid.*, Bulletin No. 6, 1883, pp. 3-32. Economic Relations of Wisconsin Birds, by F. H. King;

Wisconsin Geological Survey, Vol. I, 1882, pp. 441-610. Report on the Birds of Pennsylvania, with Special Reference to the Food Habits, based on over Four Thousand Stomach Examinations, by B. H. Warren; Harrisburg, E. K. Meyers, State Printer, large 8vo, pp. 434, plates 100. The English Sparrow in North America, especially in its Relation to Agriculture, prepared under the direction of C. Hart Merriam, by Walter B. Barrows; Bulletin No. 1, Division of Economic Ornithology and Mammalogy of the United States Department of Agriculture, 1889. The Hawks and Owls of the United States in their Relation to Agriculture, prepared under the direction of C. Hart Merriam, by A. K. Fisher; Bulletin No. 3, *ibid.*, 1893. The Common



FIG. 29.— BOBOLINK.

Crow of the United States, by Walter B. Barrows and E. A. Schwarz; Bulletin No. 6, *ibid.*, 1895. Preliminary Report on the Food of Woodpeckers, by F. E. L. Beal; Bulletin No. 7, *ibid.*, 1895. (See also other papers on the food of birds in the Annual Report and Year Book of the United States Department of Agriculture.) Birds as Protectors of Orchards, by E. H. Forbush; Bulletin No. 3, Massachusetts State Board of Agriculture, 1895, pp. 20-32. The Crow in Massachusetts, by E. H. Forbush, Bulletin No. 4, *ibid.*, 1896. How Birds Affect the Farm and Garden, by Florence A. Merriam; reprinted from *Forest and Stream*, 1896, 16mo, pp. 31; price, 5 cents. Birds in Horticulture, by William E. Praeger, read before the State Horticultural Society, Springfield, Illinois, December 26, 1899. Our Native Birds: How to Protect and Attract them to Our Homes, by D. Lange (The Macmillan Co.). Birds, by Annie M. Grant, Report of R. I. Board of Agriculture for 1899. The Birds of Ontario in Relation to Agricul-

ture, by Chas. W. Nash, Ontario, Department of Agriculture, Toronto. The Danger of Introducing Noxious Animals and Birds, by T. S. Palmer, Year Book of the United States Department of Agriculture for 1898, Washington, D. C. Birds as Weed Destroyers, by Sylvester D. Judd, Year Book of the Department of Agriculture for 1898, United States Department of Agriculture, Washington, D. C. Economic Relations of Birds and their Food, by F. E. L. Beal. Proceedings Twenty-fourth Annual Meeting of the New Jersey State Horticultural Society, 1899. Birds of Village and Field, by Florence Merriam Bailey (Houghton, Mifflin & Co.).



FIG. 30.— BLUEBIRD.

Mr. HINMAN. I would like to ask one question of Mr. Chapman. I was not quite certain that he gave us definitely the difference between a night hawk and a whippoorwill. I should be very much pleased if I could be absolutely certain that there is a difference between our night hawk and our Connecticut whippoorwill. I know that what we call a night hawk is one of the commonest birds in the summer time. It nests on a rock. It lays its eggs on a bare rock. Its eggs are a granite gray. The bird is a granite gray as it sits upon the rock. The male bird sits upon a rail, and looks like a knot raised up on the rail. That is what we call our night hawk. Now the very same bird, so far as I could see, is what we call a whippoorwill. I never but once came across a bird that ap-

peared to be different. It laid its eggs, not upon a rock, but upon the brown forest leaves. Its eggs were brown. The bird itself was brown like the leaves, and the question has always been with me whether there was not something about that bird like the chameleon stories that I read in my boyhood days in school. Something of a change of color. There was the same bird apparently in every single particular, only one bird laid its eggs upon the leaves, which were brown, and the eggs were of the same color, its young were the same color, and when the young bird grew up it still went through the air collecting its insects with that same peculiar cry that goes with them. I have never ascertained definitely whether there was a difference, from the simple fact that I never had the heart to shoot a whippoorwill. Never in my life, and I have lived for sixty years where the whippoorwill is one of the commonest birds we have, and you can shoot it any summer night, but I never had the heart to shoot one to satisfy myself whether there was a particular difference. After hearing our friend who has been talking to us to-night, it occurred to me to ask if there was any way an ordinary man, who lived on a farm, could distinguish any difference between a whippoorwill and a night hawk.

Mr. CHAPMAN. In reply to the gentleman, I would say that he gave an excellent description of a night hawk, but the bird that you described afterward, the brown bird that laid its eggs upon the brown leaves, was the whippoorwill. Now, I imagine it will be difficult for him to accept what I say without some proof, and I have no specimens here, but I can tell one thing which may aid in converting the gentleman to the idea that they are really two birds. The night hawk and the whippoorwill have very similar nesting habits. They both nest upon the ground; upon the bare land, or upon the leaves as you described. They build practically no nests, but the night hawk, in feeding, flies high above the ground, and goes through the air with a peculiar sound, and catches its food much as the

chimney swifts do. It has the faculty of changing its home. In the cities we have the night hawk. It is a common summer resident of New York city and Brooklyn, and it nests in these cases on the tops of houses, generally in the gutters of the houses. It's a granite bird, which lays a granite egg, but it is not the bird which we call the whippoorwill.

Mr. HINMAN. Mr. Chairman, I want to ask once more if the gentleman has any idea that if I stood in my front door in the early summer, and shot a bird that was saying "whippoorwill," and sent it to him, that he could tell the difference between that and a night hawk?

Mr. CHAPMAN. Certainly. I could tell in a moment upon looking at it. The wing of the night hawk has white spots which cross three, or four, or five of the feathers about two-thirds of the way up. When you see a bird that has these white spots very conspicuous you may know it is a night hawk. The wing feathers of the whippoorwill have a rusty, brown-colored spot, about three or four, on several feathers. So if you will send me a single feather I can tell. But if you tell me that the bird with a white spot on its feathers was saying "whippoorwill," I shall certainly be much interested.

Mr. HINMAN. I will not shoot a night hawk nor will I shoot a whippoorwill. I will take the gentleman's word for it that they are two distinct birds.

Secretary GOLD. Before we adjourn I wish to give the announcements for to-morrow.

I have here some of my reports of farms for sale in Connecticut, often called "abandoned farms." They are very far from being abandoned farms. No abandoned farms practically exist in Connecticut. They are owned by somebody, and are kept by somebody for pasturage, or for growing wood, or for other purposes. In the list are some valuable and attractive farms, which must be sold on account of the convenience or comfort of the families that own them. On that account they are necessarily in the market. From one of the lectures

that we have had to-day we can see that the tide is about turning, and the people are going back to these farms. It has turned in some places and agricultural property is at a premium there. But there are many places left yet where it is at a fearful discount from what everybody considers to be its true value, or from what has been its value in the past, or what I believe will be its value in the future. If you do not find a supply of these reports here, you can get them by addressing me at West Cornwall, without expense to you.

I have brought here a little sheet that is distributed around the hall, offering reports of the Board of Agriculture, and stating those that we are ready to give away to all applicants and those that we desire to collect, so that we may complete sets for institutions of learning and libraries generally. If you knew the interest that many of our western institutions, and others in some of our cities, and even in foreign countries, take in getting possession of complete sets of our reports I should not be around here offering to you sets of these reports to lay them up in your families for family reading, or in your village and country libraries. If I had time I should like to lay before you some of the interesting letters which I receive in connection with applications for sets of these reports. There is an opportunity for all to get them from 1879 onward. If you have any of the years previous to that, you will confer a great favor on somebody if you will send what spare copies you have to me; that is, copies of the years previous to 1879.

I have got a little notice that goes with that, which I desire to present, and that is, I wish you would report upon some of the remarkable, large, old, historic, beautiful, and curious trees in our State. You cannot drive five miles in any part of the State with your eyes open but you will see something in the way of a tree as beautiful as those trees we have seen upon the screen here to-night. If you find one of these curious and interesting old trees, a photo of it can be taken. You need not get it finished up. Just send me the

negative, as this is better in preparing a plate for printing, than the finished picture. Bear in mind that it will cost you very little to have photos prepared so that some of your favorite trees can be presented with the descriptions of them. Send them to me. I would like to publish the entire list. I have published several lists when photography was not so perfect and so cheap as it is now. Some of the pictures I have seen made one think of the pleasure of lying under their shade and enjoying their beauty. Please bear it in mind.

The PRESIDENT. We will now adjourn until to-morrow morning at ten o'clock.

MORNING SESSION.

Thursday, Dec. 14th.

Convention called to order at 10 A. M., his Excellency, Governor George E. Lounsbury in the chair.

Governor LOUNSBURY. I have known many farmers, and many good citizens, who were not successful citizens, but I never knew of a good citizen who was not a patriot. The choir will now give us a patriotic song.

"America," rendered by the musicians from the Connecticut Agricultural College.

Secretary Gold calls the attention of the audience to a printed sheet distributed in the hall, giving interesting information in regard to the census to be taken in 1900, and which gives specific instructions relative to what farmers will be required to answer to those who will collect farming data.

Secretary GOLD. I have a question here this morning on a subject that is really interesting. "Is there any chance to improve the Institutes as held in our State?" Can anybody tell us how to get the people out? The list of speakers that we offer for these institutes are such as you could not hire

to do the work that they are willing to do for the value of the products of some of your farms, and this year we are furnishing them gratuitously all over the State. The wonder is, that the farmers generally have something else to do on that particular day. It seems as though a notice given two or three weeks beforehand to the farmers of a locality ought to be sufficient so that they and their wives and daughters and sons could all be ready for these occasions. Sometimes we have halls well filled at some of our local institutes, but that is not the usual experience. There is a company of speakers provided that are capable of interesting any audience upon matters vital to our calling, and they sometimes have to speak to almost empty benches. I think it rests with the people of a locality, and if each one of the farmers in that locality would give a little prod to his neighbor on this question it would help out considerably.

Mr. Hale. Mr. Secretary, in reply to that inquiry, I want to say just a word. I don't know as I would attempt to answer it just as it is put there, as to how to improve the institutes, but how to get greater results out of the institutes, I think would be a question worthy of discussion. Under the present plan of conducting the institutes, which is for this Board of Agriculture to engage a certain number of speakers, and then offer them to the people who want them, I do not think we get the results we ought to. You hold an institute where the people are wide awake and full of energy, — if they ask you to come there and you go, it is likely to be the very community where you don't need to go. It seems to me, instead of offering an institute to people who want it, and then going there, that it would be better, and you would get greater results for your money, if you would search out the towns that need to feel the influence for good of an institute, and then go to those towns whether the people want it or not. Carry your institute right into those towns, no matter what the people want, and as for an audience, you can get that anywhere if you advertise properly.

Let some one go ahead and advertise. Advertise pretty thoroughly. The more thoroughly you advertise the better the attendance. It seems to me that if Boards of Agriculture are not accomplishing the good they ought to it is simply because they are in the habit of offering the people these institutes, and if they are wanted you go there at considerable expense and yet not reach the very people that ought to be reached. Now, I believe that the Board of Agriculture, by pursuing a systematic course, and arranging these matters ahead; indicating a number of towns, or laying out a regular route, if you will, that the Board proposes to cover in the institute season, and then going there by some of your committee and arranging with a few citizens, farmers, whom you could certainly depend upon for the opening of a hall, and for a certain amount of local entertainment, and then secure the names of a majority of the farmers within a radius of ten miles of that place, and have that list of names on file in the secretary's office ready to be used to notify them, and then when the Board decides to go to a certain place you are in a position to accomplish something. Out in the state of Wisconsin they beat us all to pieces in the holding of institutes. I have been to institutes in Wisconsin where 1,500 farmers have been in attendance, some of whom had traveled thirty miles to attend that meeting, and they would not go home or miss a meeting until it had adjourned without day. The way they do is for the secretary to ascertain the names of a certain number of farmers within a radius of twenty miles of the place where they propose to hold a meeting, and then about ten days before the meeting takes place, they send out a program of what is to be done at the meeting. They send out this program generally. Send it out to all these people, and it is read, and the farmers know what is coming. Then, about three days before the meeting, a postal card is sent out, calling their attention again to the meeting, and asking, or, rather, inviting them, to be present themselves, and to get all their neighbors in with them to come

to the meeting. The result is, they beat us immensely in the attendance, and they give a definite program, just as it is advertised. That is a strong point. There ought to be a well-defined, definite program of this kind carried out. But it is far better to use a thorough system of advertising, which will bring out the people, than it is to pursue some plan which costs only a small amount of money, and does not do as much good. A thorough system of advertising costs but a little more, and then your institutes do some good, and you get much better results for your money.

Mr. James Tufts. Mr. Chairman, I think your institutes in Connecticut are conducted very much as they are in Massachusetts, and I think if you would take a little more pains to interest the farmers around, and call upon them to give their experiences it would add to the interest of the meetings. Consult with somebody who understands the farmers in the locality where your institute is held. This farmer has had a successful crop of this kind or that. Let him appear and give an account of it. If you have more of such work in the institutes they would be more interesting, and the farmers would come if it was rightly advertised, and rightly managed, and rightly worked up, as the gentleman (Mr. Hale), has just told us. The farmers will go to these village shows, or where there is nothing but just a circus, or horse racing, because it is interesting to them, and because such things are well worked up and advertised, and they would go to the farmers' meeting if it was rightly attended to and rightly managed. If it is well handled, they will place their shoulders to the wheel and help it along, because it is a good cause in which they are all interested, and which ought to do a great deal of good, and it would do a great deal of good if some way was devised to prevent the waste of real ability at these meetings, because there are so few present. I think there would be more present if more farmers were interested, and it would tend to draw out the farmers more

if this one or that one who has done well with this crop and that crop should be asked to appear and tell about it.

A MEMBER. I believe that the reason the institutes are so slimly attended many times, even ninety-nine times out of a hundred, is, that the farmer has not been there and he don't know what they are. After he has been once he makes up his mind to go the next time if he lives.

Secretary GOLD. Here is a question for somebody to answer. "What work will the Morgan Grape Hoe do in cultivating an Orchard?" Who is using that?

Mr. HALE. I am not using it myself, but I think Mr. Ives may be using it at Yalesville, and, perhaps, Mr. Warner down in North Haven. The term "Grape Hoe" is applied to it, and I think interferes with its general use. It is made by the Syracuse Plow Company, and called the Morgan Grape Hoe, but it is really a cultivator or small plow, working off to one side of the horse, and enables you to do cultivating up close under the trees. It is certainly a very valuable tool for cultivating close under the trees where you could not work a common horse hoe to good advantage, but the term "Grape Hoe" has killed its sale because it is misunderstood.

Sec. GOLD. Anyone else had experience with this tool?

Mr. WARNER. I never used it. Mr. Platt told me that he did, but he is not here. I think he has made a good deal of use of it. He said that it cuts up close around the trees, and does the work there which otherwise would have to be done by hand. You can go very closely with it. For the last two years he has run it, and it has saved a great deal of labor in cleaning the space around the trees by hand. He thinks it is a valuable tool. I have seen the work that he has done with it, and think it a very useful tool for those who have that sort of work to do.

Sec. GOLD. I received a communication last evening, prepared at my request, that I wish to present to the Board at this time. It is a brief sketch of one of the former members of

our Board, Mr. John T. Rockwell, late of Winsted. I received this communication from Mr. Vaill who prepared it, and I take this early opportunity of presenting it to the convention.

SKETCH OF JOHN T. ROCKWELL.

By Joseph H. Vaill.

" John T. Rockwell was a member of the State Board of Agriculture for eleven years, his service terminating in 1881 when he removed from Winsted to East Orange, N. J. He died at his home, in the latter place, June 13, 1899. Mr. Rockwell was born at Colebrook Jan. 21, 1827, and was the son of Theron and Clarissa Treat Rockwell. The district schools and a course at Williston Academy at Easthampton, Mass., summed up his educational advantages, at least as far as text-books were concerned, though his education did not terminate with his school days. He continued to be a learner, if not a technical student, all through his long and active career, the result being to equip him for excellent service in public affairs as well as in his own private business.

" He was blessed with a good heritage,— that of his sturdy New England ancestors. His grandfather, Elijah Rockwell, was the first justice of the peace and town clerk of Colebrook. His father was a prosperous tanner, and at his death in 1848, his sons, James S. and John T., continued the business with marked success under the firm name of J. S. Rockwell & Co. Their increasing business demanded increased facilities for the production of their wares, book leather, and large tanneries were built in Winsted and Brooklyn, N. Y. In 1852 Mr. Rockwell removed from Colebrook to Winsted, where he resided until after the death of his brother, when he removed to New Jersey, and became sole manager of the company's affairs at its New York office.

" Though he never was an office-seeker, Mr. Rockwell re-

luctantly yielded to the demands of the townspeople, and filled various public positions as selectman of the town, and as representative in the lower branch of the State legislature he rendered painstaking and efficient service. He was chosen a delegate to the National Republican Convention in 1876, and, though a consistent believer in, and defender of the dominant principles of party, yet he lacked the characteristics of the ordinary politician, regarding the public welfare paramount to party success. Personally, Mr. Rockwell was regarded as one of nature's noblemen wherever he was known. He was so thoroughly imbued with gentlemanly instincts as to make him highly esteemed by all classes of his townspeople. He was generous to an unusual degree; fond of a good story, and possessed of the faculty of telling one to good advantage. He was much interested in agricultural matters, and was the first to introduce Jersey stock into Winsted. Referring to Mr. Rockwell, Secretary Gold gave the writer of this sketch his estimate of his services and character. 'He was a very efficient member of the Board, and punctual in the performance of every duty. His influence and advice was most valuable, while his general bearing and his character made him a worthy companion for any one who had the privilege of his acquaintance. It has been one of the chief pleasures of my life that I have had the opportunity of associating with such men.'

"Mr. Rockwell is survived by his widow and two children, a son and daughter, his son, Theron, conducting the business of his father as successor to the old established house of J. S. Rockwell & Co. Winsted's most conspicuous feature is the Soldiers' Memorial Tower, which stands upon the hilltop in the central portion of the town in Memorial Park, which was Mr. Rockwell's gift to the public. You can all see this when you go through Winsted if you look for it on the hills overlooking the village. Though his modesty impelled him to stipulate that the park should not be given the donor's name lest it might be

thought unfitting, yet Mr. Rockwell's memory will long be cherished by his former townsmen."

I see one of our old board here that I know was associated with Mr. Rockwell, and I will call upon Mr. Stewart of Middle Haddam to say a word in his memory.

Mr. STEWART. During Mr. Rockwell's connection with the Board of Agriculture I was a member of the Board, not only at that time, but before and after, and during all his connection with the Board he was always ready and always willing to do his share of the work. In fact, he was a very assiduous man in doing his work. He was always ready to do it. He was one of the most efficient members of the Board. After what has been said in that paper, it is out of place, I think, for me to make any further remarks in regard to Mr. Rockwell.

[Music by the Orchestra.]

Governor LOUNSBURY. One of the most wonderful papers ever written by man said of the ideal home of the future that there shall be no more sea. Why these strange and striking words were spoken, or written, I will leave it for you to ascertain next Sunday at your homes. You will now listen to an address on the sea by Mr. Henry P. Hedges of Bridgehampton, N. Y. And let me say here that although on the program Bridgehampton is put down as belonging to New York, it should belong to the State of Connecticut, and for two reasons: first, because 150 or 200 years ago it was a part of this State, and, secondly, because almost all the good people, and almost all the people there are still good Connecticut folks. I can say nothing better, therefore, of Mr. Hedges than that he comes from good Connecticut stock, and I can say nothing better of good Connecticut stock than that Mr. Hedges is its good representative. Mr. Hedges is a modest man, and does not want to get above the plane of his audience, and prefers to speak from the floor rather than from the platform. I have the

honor and pleasure of introducing to you Mr. Hedges of Bridgehampton.

Mr. Henry P. Hedges. Mr. Chairman, Ladies and Gentlemen of the Board of Agriculture of the State of Connecticut: In your name your indefatigable secretary invited me to speak of "the sea" as distinguished from the land. With pleasure and thanks for the high privilege I accepted.

Your secretary knew that I was born and had resided on Eastern Long Island over four score years, that there in our earliest and latest days and over our graves is the ocean's roar, our unceasing harmony in life, our dirge in death.

He knew that by location we with you were attracting commerce, trade, manufactures, and development of our waters, away from the culture of the soil. By steam power the world competes with the farmer, so that in our old routine of staple crops, corn, oats, wheat, our labor is measured by that of the serf and not of the freeman. The shores of Long Island and of New England have become the summer resort of increasing thousands of visitors, thereby modifying the culture of products of the soil, and seemingly destined to work an entire and a paying revolution in agricultural operations. The day is not quite here, but is coming. Meantime the farmers on opposite shores of Long Island Sound are asking each other across the waters, "What shall we do to live as freeman ought to live, training our children so that they will know their rights, and knowing, dare maintain?" Underneath all industries, all arts, lies the bed rock of agriculture. It may be depressed, and is so now, but out of the deep comes the voice of hope. Adjust the culture of the soil to the changed conditions. Develop all that the waters will produce. All that dews and rains will not fail to nourish here as elsewhere they often fail to do. Utilize labor-saving means. Prepare for more and more summer visitors, more and more fresh products of land and sea. This adjusting era is the time to try our faith and courage. Farming fail! Never, until man can survive without sustenance! This is the time for farmers to say as seamen say when chasing whale, "Now for a long pull, and a strong pull, and a pull all together."

By the logic of location New England and Long Island are the sanitarium of the nation. The mountains of the former and the shores of both have made them so. The historian of

New London writes, " Here lies Connecticut and Long Island forever looking at each other from their white shores with loving eyes, linked as they are by the ties of a common origin, congenial character, and similar institutions, and guarding with watchful care that inland sea which, won from the ocean, lies like a noble captive between them, subdued to their service and enclosed by their protecting arms."

Our food contains a large quantity of water. The amount would be nearly as follows:*

Of these twenty articles of food two contain fifty per cent. water, six less than that, and fourteen more. In this list, fluids like tea, coffee, cocoa, and soups varying eighty-five to ninety-six per cent. of water do not enter. Enough appears to show that more than two-thirds of our food is water.

Of these 20 items, Long Island produces all except the oranges, and Connecticut almost the same, and both largely by proximity to the sea, its waters forming so much of their substance. In two of our towns, cauliflower estimated at 162,500 barrels, at $2.00 per barrel, and amounting to $225,000 were shipped this fall. Our county is reported to produce more cauliflower than all the other territory of the United States. Cabbage, cucumbers, onions, beets, turnips, strawberries, and asparagus are cultivated at a profit in our county. Potatoes are our largest crop with a paying average yield and so fine that the price in the New York market ranges from ten to twenty-five cents higher per barrel than those raised elsewhere. The more water a crop contains the less it draws from the soil, *a problem* we are now studying. Our blue fish, striped bass, and Blue Point oysters cannot be unheard of. The product of our great South Bay alone is estimated at nearly $2,000,000 in shell and other fish. Ninety-six steamers of the

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* Vide Year Book of the United States Department of Agriculture, 1895, pages 573 and on.

	Per Cent.		Per Cent.
Beef, fresh,	50	Beets, fresh,	70
Mutton, "	45	Cabbage, "	76
Pork, "	40	Potatoes, "	67
Fish, "	38	Turnips, "	62
Clams, "	50	Apples, "	61
Oysters, "	88	Blackberries, "	88
Eggs, "	66	Oranges, "	64
Milk, "	87	Pears, "	62
Bread, "	35	Raspberries, "	85
Asparagus, fresh,	94	Strawberries, "	81

American Fisheries Company report a catch of menhaden this season at 262,500,600, valued at $1,000,000; taken chiefly in waters adjacent to Long Island.

We speak of the "waste of waters" because they cover nearly three-fourths of the earth's surface, as if in the Divine harmony of creation, God had mistaken the just proportion of land and water. We forget that the food we eat contains no less proportion, that man in his living organism solid and fluid, is in miniature and symbolism not unlike the globe we inhabit. Think of a temporary drouth, and the famine that follows. Think of its continuance and of augmenting misery. Think of a world where no water is, and you think of a climax of torment chosen by inspiration to portray the agony of Dives, because torment can go no farther. If, as a subject of thought, land is pregnant with profit to the farmers, water in its necessity to give profitable results for his toil, in its grateful ministry to satisfy thirst, in its cleansing power to purify the body, in its beneficent service to bear the products of land to remotest shores, in its facility to furnish food — as a field for the finest skill, the most adventurous enterprise, the most magnificent genius, the most daring valor, ocean yields nothing to land. Its study may satisfy us more fully of His wisdom in the creation of the world, who "hath founded it upon the seas and established it upon the floods."

Does the configuration of the continents tell their possibilities? Asia, with her 30,800 miles of coast line, has one mile only of coast to 459 of surface; Africa, with 14,000 miles, has 623 miles of surface to one of coast; South America, with 14,500 miles, has 420 of surface to one of coast; North America, with 24,500 miles, has 350 of surface to one of coast; Europe, with 17,000, has 156 of surface to one of coast. Japan, in location, seems to Asia like the British Isles to Europe, and is the only Asiatic power aroused from the lethargy of ages to the benefits of commerce. The map shows Africa and South America with smooth coasts like two vast Russian territories, wide at the tropics, tapering towards the poles, and unfitted for marine supremacy. Europe puts out cape and promontory, peninsula and headland on all her three water bounds, and smallest of continents has hands and arms, feet and legs, lacking in other continents, that successively have made Greece and Rome, Venice and Portugal, Spain and Holland, victors

in ocean war. Is not her greatest proportion of coast mileage the preponderating cause? The United States, with climate genial, two oceans almost encircling three sides, her border lakes, her abounding arterial rivers, her mineral wealth, her ship-building material, her varied, immense, and yet undeveloped production, bears on its surface capacity for a commerce in volume yet unknown in the world's records, and a naval supremacy unrivaled by any single power on other continents. In the War of the Revolution, and of 1812, the British fleet rode triumphant in Gardiner's Bay; our patriotism should prevent the like presence of that or any other fleet in coming ages. And England, our mother-land, with her 2,000 miles of coast line, her magnificent harbors, and unbounded enterprise, England, from the days of the great Armada, has maintained a commerce world wide, a colonial empire encircling the globe, a naval supremacy that successively wrested the sceptre from Spain, Portugal, Holland, and France, and made Waterloo possible. Her larger coast line, three times longer than that of France, enables her to raise more seamen, and hence her supremacy. The map of the British Isles speaks this to the eye.

Write the history of the Mediterranean Sea, and you write the history of the ancient world. On its shores rose Tyre and Sidon, Egypt and Troy, Greece and Rome, Carthage and Venice, Spain and France, at different times predominant on the sea, and thereby over other nations. It has borne the navies of victor and vanquished. The story of the Argonautic expedition in quest of the golden fleece, the fate of the 1,183 ships sailing from Greece to the siege of Troy, the ignominious overthrow of Xerxes, the battles of Thermopylæ, Marathon, and Salamis, the mighty names of Scipio and Hannibal, of Pompey, and Cæsar, of gods and demi-gods, live with the records of this inland sea. If the historic end of the world extends back forty-five centuries, the history of this sea covers eight-ninths of that era. What the Mediterranean Sea was to the ancients, the Atlantic is to the moderns. Transportation now from London to New York is as expeditious as formerly from Athens to Egypt, or Rome to Carthage. The power that is supreme on the Atlantic is invincible against the world. Great Britain accepts and acts on this principle as an axiom. The United States may wisely do the same.

The examination of the sea coast is a wonderful study, showing some compensation for every disadvantage. The rocky shores of Maine and Massachusetts, down to the vicinity of Plymouth, abounds in harbors of safety from the perils of fog, wind, and wave. The sandy shores of Cape Cod and its vicinity, failing to open harbors, are not so perilous to life and ship as a rock-bound coast. The more rocky and dangerous part of the Connecticut shore opens to the mariner more frequent havens of refuge. The shores of Long Island present like features. It is as if the creative power in tenderness for the navigator with increasing perils had provided increasing avenues for escape. As if on the rock and on the shore he had written in lines of lasting endurance the monuments of His mercy and His goodness.

Surrounding waters laving shore, and stopping there leave the land an uninhabitable, unproductive, parched waste. He who made them enveloped them with an encircling atmosphere miles on miles in height, with a benign power when heated by the sun to lift into its embrace from sea and ocean, lake and river, pervading volumes of water, and carrying it over isle and continent, drop it from the clouds to enrich and rejoice the earth. The parched hills of Connecticut in dearth and drouth, telephone to the sea, and clouds, the great water-bearers in the heavens, move over the sphere of desolation and drop their precious freight in gladness on the soil.

The current from the North Pole flowing south freezes this continent nearly through Labrador, bringing with it icebergs, and making adjacent land a cheerless desert. Across the Atlantic, in nearly the same latitude, lie the British Isles in marked contrast, with genial climate. Why? The Gulf of Mexico, almost encircled by this continent, receives from the coast of Africa a vast stream following the southeast trades, heated under the Equator, which, coursing around the gulf, is projected from its northeastern rim with a velocity powerful enough to run near our coast, and temper our climate somewhat north of Montauk Point, where it is seaward about 110 miles. Thence it moves in a curve, bathing the shores of the British Isles, bearing warmth, fertility, comfort. Writers have termed the Gulf of Mexico the great teakettle of Great Britain. Blot out that gulf and England loses her genial climate, her

abounding prosperity, her favored lot, and, perhaps, her naval supremacy.

Understanding something of the magnitude of this subject and of the qualities evoked by ocean life, we can better estimate whether national pre-eminence is promoted by maritime location, whether the seacoast concerns the character, welfare, comfort, attainments, momentum of its residents. If it were practicable by vote to do so, would the borderers on Long Island Sound, on the Connecticut River, on the magnificent harbor of New London, vote to fill them up, exchanging land for water? This case is put not because of a doubt what the vote would be, but, if God has *so* made one part of this country, which we know, that we see in it the working of a hand, as wise, as beneficent as it is mighty, may we not infer if the little we see speaks thus, what we do not well see and know, may speak the same language and evince the same benignant design, thus enlarging our contentment and confirming our faith.

What traits of character does life on the sea develop? The sight of a sailor three sheets in the wind may satisfy the surface thinker of the imprudence and improvidence of seamen, and seemingly stamp his character, yet, a drunken sailor is no more an index of seamen, than a drunken farmer would be of farmers. In a long life of intimacy with seamen I have observed some qualities of mind and heart, brought out by conflict with wind and wave. What elements are more baffling and uncertain? To-day a calm, to-morrow a storm; now all sun, and now all darkness; now in mid-ocean, and now on a lee shore; tides now rising, and again receding; streams, and currents, and eddies, and whirlpools, coming we know not when, going we know not where. What occupation can demand or educate to more careful forethought than that of the navigator? The popular notion that ascribes to the sailor the trait of thoughtlessness is a popular mistake. He is, and necessarily must be, a man of intense forethought.

The oar and sail were joint ship-moving powers until past the days of the roving Vikings. Topmasts superseded the heavy single mast after the day of Columbus; high castles aft for officers, forward for seamen, were not disused until after the time of the great Armada, and our word " forecastle " has survived its literal meaning. If the curve, the least impediment to water, was undiscovered until our day, the like in the

plow to the furrow so remained. It is something to know how to put your hand on any rope in a full-rigged ship the darkest night, which a landsman knowing not, knows himself "a land lubber." I risk nothing in calling the seamen inventive; I need not say the sailor is enterprising, his calling stamps him that; I need not say he is broad minded, his voyages to remote regions make him so; conflict with elemental forces compels him to be resolute. His life is eminently a continued combat to overcome obstacles, and a man's measure is his power to overcome opposing forces. The more he can overcome, the stronger he is, and the more he weighs in the scales that measure power — so weighed the sailor will not fail to attain the full standard of manhood. Responsibility he cannot avoid, and, hence, is self-reliant; in the calm he must be patient. Squalls are quick, emergencies sudden, and must be met by thought as quick, decision as sudden. In the long night watches the stars in the heavens speak to him, "Day unto day uttereth speech, and night unto night showeth knowledge." He becomes not only a quick and a precautionary, but a deep thinker. Among the most profound thinkers I have known may be numbered the master mariners from our own seaports. We of the land tread the marked and beaten road, the voyager on the ocean finds no guideboards and no milestones. With the most watchful vigilance the heavens may be darkened so long, or the elements rage so furiously, as to make his location uncertain and his shipwreck unavoidable. He often meets those who have so suffered, and knows not when their hard lot may be his own, hence his gentleness to the unfortunate and his known generosity; virtues found nowhere else more conspicuously.

If athletics, now so prominent in college life, mean anything in enlargement of strength, health, and life, the conflicts of the sailor with opposing elements mean more, because one is temporary, the other enduring contest. Admit all that the victor in the boat race can claim, victory is bought at the expense of the vanquished. In the whale chase the trophy gained by the victor is so much rescued to add to the world's wealth, and costs no humiliation of defeat. In all naval victories our athletic whalemen, made more so by training, have been a conspicuous element in achievement.

If mountains are the stronghold of freedom, its cradle in

infancy, its grave in death, the ocean is not less its nursery and abode, swung from all obstructions of shore, all unmeaning restrictions of society, rocked on the surges of its vast expanse.

> "Our thoughts as boundless and our souls as free,
> Far as the breeze can bear the billow's foam;
> Survey our empire and behold our home."

This transport of being, this ecstasy of disenthralment, this largeness of thought, is the impulse of which freedom is born and ever lives.

Law.

On the land man is subject to law as enacted or adjudged by influences, temporary, local, sectarian, municipal, narrow. On the mighty deep no village ordinance, no restricted legislation, no purchased legislature rules. What the universal judgment of mankind dictates, freed from all that is local or transient, that is law. Extend through to the widest bound of man's discernment, go down to the bed rock of everlasting equity and justice, go up to eternal harmony, and find the law of nations and of the stupendous ocean. From the day of Noah, God Almighty's master mariner, intellectual enlargement was born of the mighty deep. I need not name the great navigators of ancient or modern times. The great naval commanders of our own land are a living and a lasting testimony thereto. What enlarged wisdom, what profound sagacity, what discreet decision, what heroic valor, what intuitive genius, what faultless statesmanship glorifies the name of the victor at Manila?

Did not he who had power over wind and wave, power to magnify the loaves and fishes — to discern the miraculous draught — to know the heart of man, know the profound thought, the high-souled courage, the unshrinking fortitude, the adaptability for unmeasured devotion born of a life of conflict with the sea, and knowing this, not in ignorance, not by chance, but in infinite wisdom choose, as witnesses of His teaching, heralds of His divinity, apostles of His kingdom, ministers of His gospel, fishermen of Galilee, who would with abiding constancy, with every power of body and soul attest that gospel to man while living, nor shun to seal its truth with their last heart-beat and last expiring breath.

Lighthouses and Life-saving Stations.

The slow progress of humane relief in war, of aid to indigence, of universal philanthropy, has been equaled regarding the safety of life and ship in commerce.

Over Long Island Sound is borne the products of continents, yet, until 1795, no lighthouse shone from our dangerous Montauk Point. Eight lighthouses erected by the states in 1789 were ceded to the general government. In 1820 the whole number in the United States was 55, and in 1852, 325. We now see from the hills of Eastern Long Island eleven lighthouses.

Life-saving stations in this country originated in Massachusetts in 1789, in huts built on her coast. Congress first gave aid to this object in 1847, efficient service began in 1869.

From November 1, 1871, to June 30, 1890,

Reports show	property	lost,	$23,474,747
"	"	saved,	65,503,935
"	"	involved,	89,275,682
"	persons	"	46,061
"	"	saved,	45,516
"	"	lost,	543
"	"	succored,	8,691

The Benefits of Commerce.

Commerce enlarges thought, comfort, convenience, power, happiness. Gathering the experience and knowledge of many nations it makes them the treasure of all. Under its benign reign barbarism is local or impossible. What coal has done to warm this shivering world, what petroleum has done to illuminate its darkness, what India rubber has done to shield the human form from the tempest's wrath, what quinine accomplishes to dispel disease and death, are all the achievements of commerce. Through its ministry the men of Java and Brazil raise the coffee that adds delight to our breakfast. The Chinaman produces the tea that gives its charm to our evening repast. Toilers in Cuba and the Sandwich Islands are manufacturing our sugar, and in the East Indies producing our fragrant spices. The whole world pours its rich contributions into our storehouses.

Fisheries.

You ask me what I know about fisheries? I know that in early manhood I have seen on our ocean, miles on miles, far as the eye could reach, fish in one solid mass, and have often known 1,000,000 of menhaden taken at one haul (say 50 wagon loads). Now our shore fishing is nearly abandoned to steamers. In my boyhood wild pigeons in flocks of uncounted thousands came just after wheat harvest. I have seen not one in a score of years. The fate of the wild pigeon is coming to our menhaden, blue fish, and striped bass, is coming to the seal as it came to the buffalo. I remember when a few whale ships cruised out of Sag Harbor on the coast of Brazil, returning in six to eight months with full cargoes. Then the search extended to the Falkland Islands, around the Horn, and Cape of Good Hope, and into the Arctic Ocean, where the whales have been driven as a last refuge. The industry that numbered in our Sag Harbor nearly seventy ships, and in this country nearly 700 that always could man a navy with men as strong and brave as the world ever saw, was overdone, and now has dwindled from colossal to infant size. Our shore fishing for menhaden, striped bass, and porgies, almost destroyed by steamers, leave us yet a paying chance in catching cod and sturgeon, and on an average three or four whales each winter. Thousands of men devote their time to catching eels, clams, and oysters, and to cultivating oysters as a crop, which is an immense and a growing industry in Long Island and Connecticut waters.

In our quiet homes, secure from wave and storm, unexposed to the hazards of maritime enterprise that often loses all, enjoying the comforts of a life removed from poverty or riches, let the husbandman think of his tranquil life, his undisturbed repose, his sweet peace of mind. He has not his fortune where the wave or the rock may wreck it, he incurs no danger of breaking rope and swaying mast. Many perils lie in the seaman's way. Let the farmers' exemption fill his soul with sweet content.

The shores of continent and island first attract inhabitants, both savage and civilized. To this Long Island and all the archipelagoes witness. The emigrants to this country, with wise foresight, first located on river banks. In peace they brought to these shores the wealth of the deep and of far-off lands. In the Colonial Wars, in the Revolution, in the War

of 1812, in all the history of this free land, seamen have borne with honor the nation's flag on ocean's wave. New England cannot afford to blot out her naval history, or close her seaports to the commerce of the world. Shut up these and her power, her prosperity, and her controlling mission are gone.

The disappointments, the casualties, the disasters that occur on land are frequent and sad. Those that come on the sea are still more frequent, more unavoidable, more calamitous. A shipwreck, attended with loss of life, is a view of desolation and wretchedness that seen is stamped forever in the memory of the beholder. The swaying, pounding, rocking, groaning ship, the unfurled flapping sails, the stranded and breaking cordage, the straining spars and masts, the symmetric structure that seemed instinct with life, marred and shivering in the death agony, the remorseless, surging billows that are rolling over the wreck and submerging and drowning men, this is a sight to freeze the soul with horror. What fearful amplitude of meaning belongs to the word *wreck*, the wreck of ship, the wreck of souls. The barque ship, "Edward Quesnell," wrecked on our coast some sixty years bygone, bound to a New England port, was one of the saddest scenes my eyes have ever witnessed.

On the bank of the shore near the shipwreck were twelve drowned men, laid in a row as they were drawn from the wild, cold waves. To this day that vision of death stares me in the face, as perfect, as fearful, as pitiful, as heartrending as then.

Some twenty years ago, within less than two miles of my dwelling, the ship Circassian came ashore. A large force of workmen went on board to lighten and work her off. In the night when the tide made full and the prospect was fair to sledge her over the bar, the wind suddenly changed from blowing off to blowing on shore. The ship was on the bar, rising on the incoming wave, falling and pounding as it receded. That she must soon break in the middle, and sink the crew and workmen with herself, was inevitable. Some twelve or fifteen Indians of the Shinnecock tribe were on board, tall, athletic, powerful young men, the flower of the tribe, when they saw that death was coming did they sing the pagan death-song of the Indian of two hundred and fifty years ago? Thanks to a Christian church and training; no! The listeners on the shore, helpless to save the imperiled seamen, heard a hymn,

in our last living hour we may long to repeat. Over the noise of the groaning, breaking ship, over the shriek and howl of the tempest's wrath, over the ocean's roar, they hear in their melodious and melancholy strain those Indians sing:

" Jesus, lover of my soul,
Let me to thy bosom fly,
While the billows near me roll,
While the tempest still is high;
Hide me, O my Saviour, hide,
Till the storm of life is past,
Safe into the Haven guide,
Oh receive my soul at last."

When the surf breaks in a bend of the shore the surges roll to the center of the crescent. Gathered there, they recede underneath the incoming wave, and rise to the surface seaward at a point where the momentum of the outward current overcomes the incoming wave, that is, the undertow. Woe to the man that remains in it. If he shears out of it he is safe, resisting it he is gone. Every bathing season finds victims to the undertow. I was once in it, and near to impending death; memory flashed as lightning all the past, conscience spoke in thunder tones. Do I believe in the last judgment? I know it; I have been there.

The Mysteries of Ocean.

What mind has comprehended them? Man may ascend the loftiest mountain, tunnel and explore the deepest cave, mine the ore miles deep in the pits of the earth, but who has descended to the unfathomable depths of ocean or explored her hidden caverns and her deep dens? On the land we close the eyes of our dead and tenderly convey their bodies to the grave; on the engulphing sea no tender hand of kindred blood with sympathetic touch closes the eye, no grave of mother earth marks the place where the seamen sank. From the days of infant commerce, from historic times, the ocean has swallowed up treasure inconceivable, lives innumerable, navies uncountable, and in her depths we know not when, we know not where, lie strewn the navies submerged, the treasures hidden, the ghastly bones of the drowned, and over all this mystery roll the waves that guard their story until " the sea gives up its dead."

You look from a height, and feel an impulse to plunge be-

low. A being the embodiment of all evil tempted one, the incarnation of all good, to cast himself down from a pinnacle of the temple, assailing this weakness in our nature. A look on ocean so fascinates and attracts; its vast expanse, its measureless power, its surging billows say, come to the disordered mind; the attraction to suicide in its wave is fearful. It seems a monster, hideous, yet alluring, against which resistance is vain, from which flight is impossible. Fascination overcomes horror, the soul surrenders, and surrender is doom.

The sweat that bedews the brow of manly labor, dampens the forehead in death, in all the ages from the equator to the poles, is born of the world of waters, and is borne from we know not what spring or fountain, rill or rivulet, lake or river, or through what devious way of the heavens above or the earth beneath. The tear that drops from the eye of humanity in transports of joy or depths of woe, from the first inhabitant of the world over its wide expanse in all the centuries of recorded or unrecorded time, is born of that mighty ocean, whose billows break on the shores of all the continents, whose winds convey its waters over every cape and island, every hill and headland, every valley and plain, above the highest mountain, to fall in reviving dew or refreshing rain in the remotest land; the gift of a power as beneficent, as mighty, who is never limited, never partial, never narrow, but in universal benevolence maketh " the rain to fall on the just and unjust."

The centrifugal force of the revolving earth at the equator so far exceeds that at the poles as to raise the dimensions there and diminish them at the poles. Of the two diameters of the globe, that at the poles is about twenty-six miles the shorter. The centrifugal force at the equator just balances its additional diameter; stop the revolution of the earth and the ocean rolls to the poles, leaving the equator bare and uninhabitable; set in motion again, and the equator is submerged. An Almighty hand has moved, an infinite wisdom balanced antagonizing forces.

In all the migrations of water, in all its unnumbered changes in the ocean, in the wave on shore, in the upper air, in its descent from above, in the running rill or rivulet, not a drop is lost; the full measure is maintained, the minutest particle is undestroyed. We may believe that like it in its purity, its mobility, its endurance, virtue, honesty, righteousness, regard-

less of creed or sect, will abide all change, all ages, all adversity; undiminished, undimmed, indestructible, imperishable, guarded, preserved, secured, by the omnipotent Jehovah.

How wonderful is the circulation of the blood in the human body, impelled from the heart by the arterial channels to every part of the system, and returned there by the veins; to keep up its perpetual round while life endures. So the rising and receding tides of the living, mighty ocean pulsate through its vast expanse, preserving it from stagnation and death.

The water we drink is conveyed from center to circumference, and in response to manly labor, runs from every pore in purifying perspiration, ministering health and happiness; so the warm air lifts up out of the ocean into its sublime heights its waters, and moving clouds on every breeze traveling to far-off regions, drop their burdens and baptize anew grass and flower, fruit and tree, and performing its mission, by rivers that "to the ocean run," returns again, forever to keep on its beneficent, everlasting round. God's mighty mechanism in His material universe in ocean has its counterpart in the miniature mechanism of His creature, man.

Farmers of Connecticut. Adverse forces have wrought against the farmers of Long Island and against you. We helped build the Erie Canal, and thereby built up a competition of the boundless west against ourselves. Water that had been our gain became our loss. We shared in the taxes levied to purchase and procure territory additional to the limits of the thirteen colonies, and did so adversely to our financial interest. When the national government laid on us our share of the burden of constructing railways to the Pacific, it compelled us to contribute to find a market for a vast area to our disadvantage. For four score years the tide has been against us. Think not that I come to mourn, I come to rejoice with you that the mark westward from the Atlantic shore has been the majestic, the benevolent march of civilization and freedom. Our temporary loss has been the nation's glory and its gain. "It is a long lane that never turns." What was our transient detriment will prove our abiding advantage. If we have contributed to build up and enrich the mighty west, it is that for health and strength their people must come east to recuperate. The multiplying thousands that have moved towards the Rocky Mountains in thronging and increasing thousands return their

summer delegation to our shores, and the days of our prosperity draw nigh. If we have been tributary to the prairies and valleys of the abounding west, in return they are becoming tributary to us. If for a hundred years we have sent there our best and bravest with our treasures, our prayers, our tears, the investment will repay us all it cost, and more.

Finally, the ocean world is replete with moral lessons. It is forever salt. Where in the deep caverns of the earth is that vast, inexhaustible deposit that keeps it so? Whose Almighty hand has measured to the ocean this enduring element? The air takes up the water *fresh*, leaving the salt; whose infinite, adjusting wisdom gave it the power to thus discriminate for man's good? The ridge at the equator and depression at the poles exactly balance the revolution of the earth on its axis. Whose divine mechanism contrived this harmonious adjustment?

The Gulf Stream poured in, and whirling around hundreds of miles, so comes out as to warm North America up to Newfoundland, and dividing, runs south, to do the same for France, Spain, and Portugal, and north, tempering the British Isles, Norway, and Sweden. By whose impelling hand was this beneficent stream poured on coasts, otherwise bound in perpetual ice? The equatorial heat causes a vast volume of evaporation, replaced by polar streams, cooling there the air and water, that otherwise would be intolerable. By whose wise, creative power was this arranged? Our little pools of artificial make stagnate and die. God's mighty ocean, with tides and currents ever moving, is ever pure. Who can view the ocean in its vastness, unity, adjustments, mechanism, power, its benign office and mission, without emotion, without thanksgiving, without praise to Him "from whom all blessings flow"? If he who undevoutly contemplates the stars is mad, is not he who undevoutly sees "the works of the Lord and his wonders in the deep" also mad? To the seaman and the farmer, both living near to nature, by it the Creator speaks. A bard of your own New England has sublimely said:

"The harp at nature's advent strung,
Has *never* ceased to play;
The song the stars of morning sung
Has *never* died away;
And prayer is made and praise is given
By all things near and far;

The ocean looketh up to Heaven
And mirrors every star.
Its waves are kneeling on the strand
As kneels the human knee,
Their white locks bowing to the sand,
The priesthood of the sea.
The winds with hymns of praise are loud,
Or low with sobs of pain;
The thunder organ of the cloud,
The dropping tears of rain.
The blue sky is the temple's arch,
Its transept earth and air,
The music of its starry march
The chorus of a prayer.
So Nature keeps her reverent frame
With which her years began,
And all her signs and voices *shame*
The prayerless heart of man."

Governor LOUNSBURY. I know, without saying so, that every one of us feels that Mr. Hedges has given us an address of wonderful power and interest. Is there anyone who would like to give expression to some ideas that have been stirred within him by the words of this eloquent gentleman?

Mr. JAMES TUFTS. We read that agriculture has been one of the principal employments of mankind since the creation. I am glad to hear on such an occasion as this such a discourse; such a lecture as has been given us. While it reminds us of the sea, and the great powers that govern the sea, and that govern the land, yet how grandly the farmers here have been reminded of that great Creator without whose blessing our labor here is vain. We may arise up early and stay up late, yet, unless God gives us his blessing, our labor is in vain. We are reminded in this interesting address of this Creator, and that we are all dependent upon him.

Secretary GOLD. I feel like saying a word here. This man that has been speaking to us this morning about the sea, I have known longer than other man in this assembly, and almost in the world. We were boys together most seventy years ago, and together we have lived on the land and worked the fields of New England and New York, and we stand here together to-day to express our hope and confidence in the de-

velopment and power of our agriculture on New England soil. Notwithstanding all the discouraging circumstances that attend it, we not only meet here to bear our testimony to our faith in that Providence that has so richly blessed us in the past, but to unite in an expression of our hope and trust for the future.

Mr. HALE. Mr. President: I think all of us who have sat here for the last hour and listened to this address, while we have been charmed with the address, yet, we have hardly been more charmed with the address than with the man. We seemed to see the soul of the man who was talking as he expressed his loyal faith and belief in the sea, by the side of which he has always lived. It seemed to me as if that was the one inspiring thought through it all, if we could think of the man, and of the inspiration which has come to him through the sea itself. It is worthy of our thought that we who live and work upon the farm should live and work with just that spirit towards the land and the soil, and the things of nature that come into and from the farm, that this dear brother has towards the sea. If we could do that we should get more out of life, and know really what it is worth to live. I certainly have been charmed and uplifted, and helped by this address. Now, I hope we may hear a word from that other New York State Yankee, Col. Wood.

Col. WOOD. Mr. President, Ladies and Gentlemen: As Mr. Hale has just said, we have all been charmed with this noble address, and have felt the influence of the personality of the speaker himself aside from the inherent interest of what he said. While he has been speaking thoughts have occurred to everyone of you in connection with the sea, and to me, in its relation to agriculture, and I should say that that is the reason why the subject is upon your program. While the gentleman has been speaking three points have occurred to me. First, without the sea the land would not be habitable; secondly, the influence of the sea upon the agriculture of the world, and upon

the history of man, as it is connected with that; and, thirdly, the food of man that the sea furnishes. The gentleman has referred to the fact that but for the evaporation that takes place from the sea, the land would not have its rain, and but for the operation of rain and water upon the earth, the land would not be habitable. Man could not live upon the earth. The poet very beautifully expresses this change where he says: "The seasons come and go, but in the circle of eternal change, which is the life of nature," and he goes on to speak of this eternal change which is the life of nature. We must remember that all the time a circle of eternal change is the life of nature. There is this reciprocity in nature that the intelligent farmer needs always to understand that he may better appreciate his own situation. The sea is always taking from the land; the land receives its rain from the sea. Now what has been the influence of the sea upon the history of man? It is a noticeable thing that man upon this earth has amounted to nothing approximately, except as he has been particularly influenced by the sea. That seems a strange statement to make, but look at the geographical history of the human race, and observe if it is not so. We find those nations upon which the sea pours its waters, and they have been the countries that have produced the most vigorous races, and the races that have made the world what it is. Look at Europe. If you draw a line on the east of Europe you will find this fact: that so far as it borders upon the Atlantic's waters upon the westward coast, and the influence of the North Sea upon the north, extending southward, and the influence of the Mediterranean Sea upon the south, extending northward, — within that area you will find that man has made great progress, and strongly impressed himself upon the world. You draw a line from the eastern borders of the North Sea, north of Finland, down to the eastern terminus of the Mediterranean, and you have got all there is of the old world that has been the greatest in its influence upon agriculture. It is the influence of the Atlantic and the influence of the Mediterranean

that has marked the bounds of mankind, as it has been great for the accomplishment of great things in the world. Now, what has the sea done? It has brought its influence to bear by its water and by its air blowing over the country. We talk a great deal about the perils of the sea, and that sea faring has problems to solve and difficulties to overcome. You know that is what makes men. In the history of the human race it has been the solution of problems and the overcoming of difficulties which has brought out its latent powers and enabled it to accomplish great things. We talk about the Anglo-Saxon race being the dominant race of the earth. What has made it so? The Anglo-Saxon springs from that Viking of the north, who, in the middle ages, was the most warlike and irresistible sailor in all the world. The Viking came down from the coasts of Norway in his open boat. He conquered Great Britain. He conquered northern Germany, and northern France. He sailed around into the Mediterranean, and all along the northern coast. He was never defeated. He was the only irresistible man in the history of the centuries. In the making of the great English race there are five distinct and separate crossings. There was some Norse blood, and this man who was irresistible, because the obstacles he had to overcome at home in his contest with the sea, had made him so. It was the introduction of such strains into its blood that has made the Anglo-Saxon race irresistible upon the earth to-day. It goes right back to the force of heredity. The ancestors of the Anglo-Saxon had to overcome difficulties, and the Anglo-Saxon race itself has been solving problems and overcoming difficulties ever since. It is what has made it great, and the influence of the sea has been the foundation.

Now, the food the sea furnishes to the human race. The office of agriculture is to furnish food for the human race, and the one great competitor with agriculture in furnishing food for mankind in all the world is the sea. But the products of the sea are necessary as food for the race. The one food

supplements the other. There are chemical properties in the food of the sea that the food of the land does not furnish, and he is the most perfectly nourished man who uses both the products of the land and the products of the sea in his food. Men all over the world who live solely upon the products of the land without any of the food of the sea are not perfectly developed and nourished human beings, and the men who live exclusively upon the food of the sea, as we all know, are not perfectly developed and nourished human beings. We must have the products of the land and also of the sea to furnish what our bodies require. You know it is said that sea food develops brain, because there is a great deal of phosphorus used in the brain, and there is more phosphorus in sea food than in cereals and vegetables, so it is said if you will use a certain share of sea food it will develop brain power more than otherwise. There was a certain doctor who was in the habit of prescribing sea food for his patients. He used to tell them that if they ate food of this kind it would develop mental power. One person went to him and said, " Doctor, I have been practicing your theory for a long time, but I can't see that my brain is developed in consequence of this food. I have no more mental power now than I had before." " Oh," said the doctor, " my theory pre-supposes some brains to begin with." But there is that fact in reference to phosphorus contained in sea food that it is necessary in certain proportions for the best nutrition of the human body.

Now, the products of the sea in the way of food supplies are simply multitudinous. There are no end of books published about it. There are two or three very interesting English books upon the subject, which have been published, which any one of you could read with profit. One is " Hyde's Products of the Sea." It is a book published in London some ten or twelve years ago. Now let us look for a moment at some of the varieties. We know about the shell fish that we have here along the shores of Long Island and the shores of Connecticut.

Oysters are found that are surpassingly excellent in quality, and in almost unlimited quantities. In fact you have upon the shores of Connecticut some of the finest shell-fish that there are to be found in the world. Near Guilford, in this State, there is a spot which produces the best clams. They are equal to the best soft-shell clams found anywhere.

But the great yield of the sea for food, after all, is fish. We know how codfish have been an important factor in the food of man for centuries. We know how nations have made treaties with each other about codfish. We know how the destinies of nations have been influenced and almost controlled by this one thing, the codfish. Now let us see how the cod comes to be so abundant as to furnish more food to man than any other one creature from the sea. The currents of the sea are worthy of everyone's study. We know how the great equatorial current cuts across the Atlantic from the shores of western Africa, and flowing into the Caribbean Sea and Gulf of Mexico, causes the origin of the Gulf Stream of which the gentleman has spoken. North of this is the great area known as the dark Sargasso Sea. That is not a current, but it is where the water is more stagnant than in any other part of the ocean, and in which great quantities of seaweed grow and accumulate. It is the great breeding place of the world of food for fishes. In it are bred myriads of these small creatures which are almost unnoticed by the eye. These small animalculæ — some of them you cannot see with the naked eye. The great equatorial current washes this Sargasso Sea, and carries with it masses of this seaweed, and it carries it through the Caribbean Sea. I have seen in the sea millions of this seaweed. The current swings around and detaches great masses of these weeds into the Gulf Stream, and the Gulf Stream flows on up our Atlantic coast bearing these ships of nature laden with food. We load our ships with wheat and grain, and other products of our soil, but nature loads her ships, the seaweeds, with food for countless millions

of fish, and bears it up to the north in the current of the Gulf Stream. And then what does it do? Great masses of these weeds become detached, and make the fisheries of Long Island as good as they are, because the current of the Gulf Stream brings the food there for the fish. It makes the fisheries on our New England coast as good as they are, but the great wealth and mass of these food-bearing weeds are carried up to the Banks of Newfoundland, and there the arctic currents coming down from the north meet it, and as the cold water of the arctic current impinges on the warm current of the Gulf Stream, it checks it, and causes it to flow in eddies. Now, the codfish is a northern fish, and must have cold water to live in, and so the fish come with the arctic current to where it meets the Gulf Stream, and there are found the great feeding grounds of the world. This food produced in God's garden, the Sargasso Sea, is carried on ships that nature loads, up to the Banks of Newfoundland to feed the codfish that gather there in countless numbers. There this product of the gulf furnishes the food for the fish, and they can live there in the cold water, and they can enjoy being there; for there morning, noon, and evening, nature brings their meals to them all served. Millions of dollars are invested in this cod-fishing industry. There are sixty thousand fishermen engaged in this industry in the United States, and on the coast of Norway the fishing boats are almost innumerable. A man that would undertake to count them would be insane almost. Sixty thousand engaged in this industry alone in the United States, and all nations, all along, are paying more money for these codfish than for any other fish in the world. What a marvelous provision of nature this is — the sea bearing food to certain particular fishes in certain places where the conditions are most favorable to their life and growth, and where the food brought to them brings such marvelous results.

While the gentleman was speaking I thought of one other matter which seems to me very interesting. The sea does so

much for the land. The sea gives the land its rain; the sea gives the land many of the furs and oils which clothe and warm its people, and the sea gives the land necessary food in such immense quantities. Now, what does the land do for the sea? The gentleman has spoken about the sea being salt. Now, all scientists agree that salt is an absolutely necessary ingredient for this vast expanse of water in order to bring out its munificent work for the good of mankind. The great question has been all through the centuries, what makes the sea salt. Now, here, we have again that circle of eternal change which is the life of nature. All over the surface of the land as vegetation decays, sodium is one of the elements that remain. Soda is found in all ash, and not only is it found in all ash, but in all the results from decaying vegetation, and the streams of the land, the rivers, are bringing this sodium down and pouring it into the sea. What takes place then? Now, this soda is brought down from the land, and the animalculæ in the sea furnishes the chlorine which unite and make chloride of sodium which is salt. How wonderful are the works of the Creator! How perfect is the balance of all that he has made! How complete is the reciprocity between the land and the sea!

Governor LOUNSBURY. Is there anyone else that would like to say a few words?

Mr. KIRTLAND. I am always delighted with what I hear about the sea. I believe that the sea has done its part towards the development of man. I think it has done its work in proportion. I have had something to do with the water, as well as work to do on the land. In my younger days I was a farmer and fisherman. I followed the fish business for a good many years, and I could tell some stories, that, perhaps, would be considered a little fishy at this time.

But, I thought I would give you in this connection a bit of what one of our educators has said in former days. He was a man raised in Massachusetts, and said to be one of the best educators ever raised in New England. He said: "A higher

and holier world than the world of ideas, or the world of beauty, lies around us. And we find ourselves endowed with susceptibilities, which affiliate us to all its purity and perfectness. The laws of nature are sublime, but there is a moral sublimity before which the highest intelligence must kneel and adore. The laws by which the winds blow, and the tides of the ocean, like a vast clepsydra, measure with inimitable exactness the hours of ever flowing time; the laws by which the planets roll, and the sun fades and paints; the laws which preside over the subtle combinations of chemistry, and the amazing velocities of electricity; the laws of germination and production in the vegetable and animal worlds, — all these radiant with eternal beauty as they are, and exalted above all the objects of sense, still wane and pale before the moral glories that bathe the universe in their celestial light."

Convention adjourned to 2 P. M.

AFTERNOON SESSION.

Thursday, December 14, 1899.

Convention called to order at 2 P. M., Governor George E. Lounsbury in the Chair.

[Music by the Orchestra.]

Gov. LOUNSBURY. I told you this morning how the State had lost Mr. Hedges, and the other good Connecticut people who live around him on Long Island. We met with the same loss in the case of the speaker for this afternoon. All his part of New York state once belonged to Connecticut, and if it hadn't been for the arbitrary action of an officer of the crown, the Connecticut line would be running now miles and miles west of the colonel's home. If this line had remained the same, the colonel would have been in law, as he still is in feeling, a citizen of Connecticut. And if this had been so, the place on this platform, which your servant holds by the

gracious favor of the people of this State, the colonel would have, by reason of his commanding ability. The great state of New York is none too big for him. I have the honor of introducing to you Col. James Wood of Mount Kisco, now of New York, but late of Connecticut, who will speak to you on the farmer as a citizen, and concerning his social life. I will say that the colonel himself is a bright example of the truth of his theory.

THE FARMER AS A CITIZEN AND IN SOCIAL LIFE.

By James Wood.

Colonel Wood. Mr. President, ladies and gentlemen: I have been introduced in various ways to various audiences, but never before with the distinguished honor, or of the remotest possibility of ever being governor of the State of Connecticut.

The subject upon which I am to speak to you this afternoon is, the farmer as a citizen and in social life. The day is most appropriately chosen for the consideration of this subject, as it is the centennial anniversary of the death of that great farmer, and America's greatest citizen, and, indeed, I might almost say, the world's greatest citizen — George Washington. Gladstone, himself immortalized by his genius and his commanding ability, said, looking down over the centuries, that he saw one pedestal more prominent than all others, and he would have placed upon that pedestal America's greatest citizen, George Washington. A hundred years ago this evening, this great farmer, this great statesman, this incontrovertibly great man, passed away. Two hours before his death, with that gentlemanly instinct which had dominated his life, he said to those who were assisting about his dying bed: "Gentlemen, I thank you for your kind attention; but I pray you give yourselves no further trouble on my account. I cannot last long." Can you imagine anything greater than that? And this man, three days before his death, was about the ordinary avocations of his farm. Three days before his death he was about attending to the work going on upon his estate, and the improvements upon his land, and was exposed to a storm of sleet and snow, and took a cold that resulted in that fatal attack of congestion of the lungs, which ended his life. He was a farmer and an

ideal citizen, and we have represented in him and in his career the highest possible conception of what the farmer as a citizen should be. Loving his farm, and loving his home, always giving it that attention that it needed, yet, at the same time, he was always ready to serve his country in any way that she might command.

On this anniversary of his death we meet to consider this question: "What the farmer should be as a citizen and in social life." In speaking on a subject of this kind, in speaking of a class like the farmers of the country, we are always reminded that there are two types. I don't like to describe one of these types. I do not like myself to have to speak of one of them, but it is always a delight to speak of the other. And I will ask you to permit me to read from the poet Whittier a short extract from his poem "Among the Hills," that sets before us these two types of our farming brotherhood:

> "A farmer's son,
> Proud of field-lore and harvest craft, and feeling
> All their fine possibilities, how rich
> And restful even poverty and toil
> Become when beauty, harmony, and love
> Sit at their humble hearth as angels sat
> At evening in the patriarch's tent, when man
> Makes labor noble, and his farmer's frock
> The symbol of a Christian chivalry,
> Tender and just and generous to her
> Who clothes with grace all duty; still, I know
> Too well the picture has another side, —
> How wearily the grind of toil goes on
> Where love is wanting, how the eye and ear
> And heart are starved amidst the plenitude
> Of nature, and how hard and colorless
> Is life without an atmosphere. I look
> Across the lapse of half a century,
> And call to mind old homesteads, where no flower
> Told that the spring had come, but evil weeds,
> Nightshade and rough-leaved burdock in the place
> Of the sweet doorway greeting of the rose
> And honeysuckle, where the house walls seemed
> Blistering in sun, without a tree or vine
> To cast the tremulous shadow of its leaves
> Across the curtainless windows, from whose panes

Fluttered the signal rags of shiftlessness.
Within, the cluttered kitchen floor, unwashed
(Broom-clean I think they called it); the best room
Stifling with cellar-damp, shut from the air
In hot midsummer, bookless, pictureless
Save the inevitable sampler hung
Over the fireplace, or a mourning piece,
A green-haired woman, peony-cheeked, beneath
Impossible willows; the wide-throated hearth
Bristling with faded pine-boughs half concealing
The piled-up rubbish at the chimney's back;
And, in sad keeping with all things about them,
Shrill, querulous women, sour and sullen men,
Untidy, loveless, old before their time,
With scarce a human interest save their own
Monotonous round of small economies,
Or the poor scandal of the neighborhood;
Blind to the beauty everywhere revealed,
Treading the May-flowers with regardless feet;
For them the song-sparrow and the bobolink
Sang not, nor winds made music in the leaves;
For them in vain October's holocaust
Burned, gold and crimson, over all the hills,
The sacramental mystery of the woods.
Church-goers, fearful of the unseen Powers,
But grumbling over pulpit-tax and pew-rent,
Saving, as shrewd economists, their souls
And winter pork with the least possible outlay
Of salt and sanctity; in daily life
Showing as little actual comprehension
Of Christian charity and love and duty,
As if the Sermon on the Mount had been
Outdated like a last year's almanac:
Rich in broad woodlands and in half-tilled fields,
And yet so pinched and bare and comfortless,
The veriest straggler limping on his rounds,
The sun and air his sole inheritance,
Laughed at a poverty that paid its taxes,
And hugged his rags in self-complacency!
Not such should be the homesteads of a land
Where whoso wisely wills and acts may dwell
As king and lawgiver in broad-acred state,
With beauty, art, taste, culture, books, to make
His hour of leisure richer than a life
Of fourscore to the barons of old time,

Our yeoman should be equal to his home
Set in the fair, green valleys, purple walled,
A man to match his mountains, not to creep
Dwarfed and abased below them."

There, we have described the two types of farmers. Which of the two types will the farmer of the future be? We know there are too many at present of one type that Whittier has described. We know there have been too many in the past, but we hope for better things in the future. A meeting like this must have some power in rousing the farmers out of their position in which so many have been in times past, and which, alas, too many are to-day, and turn their faces toward the bright possibility that is before everyone of us. The subject of the farmer as a citizen — that means the farmer's attitude towards his citizenship, the farmer's attitude to the community in which he lives, to his township, his county, his State, his country. The farmer's attitude begins in things close by home. His duty as a citizen begins at home. It begins with the home itself. For no farmer can be the citizen he ought to be whose home is not what it ought to be. You may rest assured that the home is the cornerstone, not only of American society, but of the American Constitution. Why are the people of this country so roused up in reference to one man having a seat in the Congress of the United States from the State of Utah? It is because there is a profound conviction in the American breast that the home must be protected. It is the corner stone of all our affairs, and the home must be right. The home must be bright and clean and pure, or the citizen who lives in that home cannot be what he ought to be in the community in which he lives.

But this home matter belongs really more properly to the second part of my subject, so let us come at once to the consideration of this citizenship in relation to our fellow men about us. The intelligent farmer must take an intelligent interest in everything that goes on in his community. It must show itself, not in this one or that one thing, but in everything. I cannot conceive of a wide-awake and intelligent man living in a community and not taking an interest in everything that is going on in that community. He must take an interest in the public schools of the district to which he belongs. I do not care what his position may be, how high he may stand,

how rich he may be, or how broad his relations may be to his fellow men, if he neglects his duty towards the primary school in the district in which he lives, he comes short of the full duties of citizenship.

The first Chief Justice of the United States was John Jay, who lived in the township of Bedford where I was born, and where I reside. After he had been Chief Justice of the United States, and after he had been minister to England, at the time when the treaty of peace with England was signed, in 1783, he came back to Bedford. He had been Chief Justice and minister, and had also been Governor of the State of New York, but he then returned from public life and settled down on his farm in Bedford, and that very year he was made trustee of the school district, and elected justice of the peace in the town, and he continued to be justice of the peace and school trustee as long as he lived. To my mind the grandest thing in the history of John Jay is, in that service to his home community, after he had held these exalted positions that men consider honorable. More honorable still was his service as justice of the peace. I have heard my grandfather say that there was no litigation in the town as long as John Jay occupied that position. If there was a dispute between two men, the man who was in the right, or not consciously in the wrong, would say to his opponent, " I will take you before the Governor." And they would go before the governor, and the matter would be settled. The governor's word was law. It was considered among the people of the town, that if they took their disputes before the governor, as he was called, that was the court of last resort. The Supreme Court of the United States had passed upon their case and decided it. There was nothing higher. They couldn't appeal to anything on this earth after the governor had given his decision. Lawyers had no business in that community except in the searching of titles and the transferring of real estate.

The Bedford Farmer's Club was at my house upon one occasion, and the trustees of the district were about to engage a teacher for the coming year of our district school. Some how or other there didn't seem to be any children born any more in that part of the country, but we have a school, and there were two candidates for appointment as teacher. They were both well educated, and both from farmers' families, and

they both attended this meeting of the Farmer's Club. One of them had a particularly high certificate from the superintendent of schools. The other fellow had a branch of a tree in his hand of a remarkable species. He said, as he came along the road, he had seen this specimen, and he said to himself, I will stop and get that and take it up to Mr. Woods. Now, there was a man who was investigating. This specimen had attracted his attention. He had seen something that he didn't understand, and he proposed to find out about it. There is no better certificate for a man than to know that he is not too proud to learn. A man who does not think that he knows everything, and wants to learn, and has the disposition to learn, is the man for me. And so he came there and asked the question about that specimen. He says, I want to know about this thing. We talked it over. I have the honor of being a trustee in my district. I said to my fellow trustees, you go and engage that man, for he is just the chap for the children. What is the result? Why, we never had such a school for the children. That fellow had the children out every noon time, and he has taught them all about everything in his immediate vicinity. The children go home and tell their parents, and one man says: " Why, I learn more than I ever learned before at school from hearing the children tell about these things." This man is going around with the children; he is going through the woods, and instead of spending every hour they can get at some of their games or play, they are following him, and getting him out into the woods to tell them about things. Now, you know yourselves, that the children are not going to get over that. There are lots of these fellows that get degrees that can't cross the street in safety. I want somebody for a teacher that can set the children thinking, open their eyes and let them see what there is in the world. If you don't know a thing, find out about it. That's what that teacher did when he came before the trustees. That is the object of education. It gives a thirst for knowledge, and puts us into that position where we can investigate and understand. That is a great qualification for a teacher. If they don't understand, find out. The school trustee's duty, as I see it, is to get a teacher of that sort. I wouldn't allow a man to teach in the public schools unless he had eyes in his head and was able to see the things about him, and educate himself from them as well as a storehouse of

abstract knowledge in his brain, that, perhaps, he don't know how to use.

Now, that is the sort of interest that the farmer must take in everything. Take an interest in the officers of your town; in the highway commissioners of your town. Every intelligent farmer, as a good citizen, wants to know all about what is going on. He wants to know about the roads, for the roads have a very intimate connection with his business. Why are they in the condition they are in if he has reason to criticise them? How much is it costing? If they are not being improved, what's the reason? What is being done with the taxes? All these things. The farmer wants to look into these things, not in a captious way, not in a fault-finding way, but in the way that a man looks after the affairs in which he himself has a private interest. The duty of good citizenship is not simply to criticise your officials. There are lots of people that have a great talent for knowing about other people's affairs. That is so in most all relations of life. Praise your officials if they do a good thing. Every official, from the minister of your church, from your highway commissioner, right down through, likes to be told of it if they do a good thing, and if you don't do this you come short of the highest citizenship. I believe we come short of true humanity more in that particular than in almost any other thing that you can name. The minister of your church will try harder, and will do better work if you tell him once and a while that he has preached an excellent sermon, and it will do you good at the same time. You feel it in your heart. So with every official, when he has done a good thing, tell him so. If your highway commissioner has done a good piece of work, tell him he is doing this thing right, and that he is the kind of man you want. Stand by the man who does well. It does not pay to criticise the men who are shirking in their duty. Get rid of them. And so with everything that goes on, high or low, near or far away, it is your business to be interested in everything that is connected with your community of a public character, just as much as it it is your business to keep out of things that are not yours. There are a great many people who have a great talent for looking after other people's affairs, and not minding their own, but it is your business in everything that affects your com-

munity or township, or your county, or your State, to take an interest therein. If anything goes wrong, and you know of it, it is your duty to make it known. Show your interest. Make it known. It is your duty. Make it known by going to this public meeting, or to public meetings of various kinds where the interests of the community, or town, or state, are being discussed or considered. It is in such places that many times the interests of your community are advanced or retarded. Be on the ground, and see what is done.

Go to the caucus meetings of your party, and right there comes the question of your politics. What is a farmer going to do? What do you mean by politics? Politics means the science and practice of government. I can conceive perfectly well of a farmer living in Germany not having any politics, or a farmer living in Russia having no politics, but I cannot conceive of a farmer living in America and not taking an interest in politics. Our government is organized on the theory of the individual citizen looking after the affairs of the public. That is the basis of our system of government, and the man comes short of his duty who does not give attention to it. Now, you know what I mean, I think; I do not mean by politics little ways and tricks of simply getting votes, or the way of hustling around and deceiving that man, perhaps, cheating another, or patting this fellow on the back, with it all having reference to your control, or getting his vote, but I refer to a broad understanding of principles; to an understanding of the basic principles upon which parties are supposed to be primarily based, and these principles are, ordinarily, and for the most part, within the comprehension of the farmers, and it is the duty of the farmers as a class to investigate them for themselves, and, having determined how you will vote, and what is right according to your light, what your duty is, stand by those principles, and stand up for them. So, go to your party caucuses. The reason that we so frequently have men elected who are unfit for office is because the farmers as a class do not attend the primaries. You want to start things right in the beginning. If you start wrong it is very difficult to stop.

If you allow bad men to run the caucuses in the primaries, and hustle around to get out votes to carry out the purposes of such men, what can you expect in the way of government

in your township, in your county, or in your State? You have started wrong, and the next best thing is to see how you can get this machine that is starting on the wrong road back into the right one. Then, don't be afraid of being a delegate to a political convention. Don't be afraid of making known what you want. The trouble with farmers is because they do not assert themselves and make their wants known. We will talk well enough with our neighbors, and we will go to the post-office and we will talk there, and we will go into the church late because we have stayed out under the horse sheds talking, but by and by when one of us is appointed a delegate to a convention, and we go there, we are just as mum as mice. We don't dare to say a word. Can you tell me why this is so? I cannot. It certainly should not be so. The farmer should be assertive enough so that when he has made up his mind what his rights are he will have the push to carry them through. Know what you want to do. Be full of it. Talk to every man you meet about it. If you want Governor Lounsbury re-nominated, let it be known. Don't question about it until it is too late. Let it be known where you stand, you are for Lounsbury. Come out with it, and say that man is a good man. That's all there is to it. That is the man who performs the duties of citizenship. Not because he goes for that man for governor when he has been nominated, of course that is a good thing to do, but because he goes for a man because he believes he represents what the people want. Farmers, don't be afraid to speak it right out, and make the matter known. Well, you say, I am not accustomed to public speaking, and it takes a great deal of courage to get up and have something to say. That is right. That's what it takes. But there is nothing that makes me so tired as a cold, diffident man that has got nothing to say. The best speech that I ever heard in my life was up in the Allegheny mountains in Pennsylvania. Things hadn't been going right in this mountain town, and this farmer had been telling his neighbors, "I am going to give those fellows rats. I will let them know that we understand what they are up to." He got to the convention, and his friends called him out. He got up on the platform and he says, "I don't feel as brave as I did. I thought if I got at you fellows I would give it to you. But you are so close right by me that I don't feel as brave as I did. I feel like a fellow over here that went

to a grocery store, and he says, " I went out in the morning when there was a little snow on the ground, and I saw a panther track. I followed that panther track. I was determined to track her, and I followed it till four o'clock in the afternoon. I was just determined to get a shot at that panther. Well, they said, 'did you get it?' 'Oh, no,' he says, ' them tracks got to be too thunderin' fresh.' That's just the way I feel. But, I am here, and now let us look at some of these things;" and he went to work and he just knocked that machine into smithereens in fifteen minutes. He made one of the most effective speeches I ever heard. Why, because he had the courage of his convictions. The man who has the courage of his convictions can always carry his point, if his point is right, everything else being equal. But a man that has not the courage of his convictions better stay at home and saw wood. Let the farmers have the courage of their convictions, let them make their opinions and wishes known. When you get the farmers in a community to do that, they are going to rule the State and the nation. When you rouse the farming classes everywhere, so that they will speak out with the courage of their convictions, there will not be any more question about it, they are going to rule the State and the nation. I do not think we have had the courage of our convictions. I think we have been afraid to speak out. A farmer goes to a meeting with a grievance on his mind, but if he hasn't the courage of his convictions he goes home, and never accomplishes anything at all.

This brings us to the great question of party. The question of political party. I have no use for the chap that is called the independent voter. I despise a mugwump. I cannot conceive how a man can be a man and have his convictions on public affairs, and not be associated with one of the political parties of the country. Perhaps I am made wrong; but I cannot understand it. I state the question from a purely disinterested standpoint. I have not been a candidate for any position for a great many years. I have had some little experience about this thing, but I cannot understand how a man can be a good citizen and not sympathize with one or the other of the great political parties of this country. They are voting frequently on great questions affecting the interests of the country. Farmers should examine these for themselves.

Parties have been divided for a long time on the great issue of our national industries; upon the question that we call free trade or protection. Now a man that is thoroughly conversant with this question can just simply bamboozle you on this subject. He can pull the wool over your eyes on either side, but there are certain simple things connected with it that a farmer can examine and come to a conclusion for himself. In doing that he wants to consult his own interests in the light of the interests of the country at large. He will find that whatever is for the interests of the country at large is often for his own interests as an individual. Let him go at this thing in his own original way. For example, let him take a hat. We will say, here is a great question of free trade and protection which is coming up and has got to be decided. Now, then, one man says, if I can buy that hat at half price, by breaking down the tariff, I had better do it. Had I better do that? If I buy it somewhere else, and bring it here, I'll have to pay duty on it. That duty is high. It is for my interest to have a lower duty. Another man says no, it don't make any difference what you pay, for it is made in the country. You had better buy it here and let our folks get the benefit of it. Now, you may have all the professors of political economy that can lecture to you, and when they get through they will not have told you anything more. It is all there. And, by the way, that is a particularly appropriate subject, for the hatting industry is one of the principal industries in the western part of your State at Danbury. It is, therefore, an interesting subject to a Connecticut man. One of the issues that brought on the Revolutionary War was the question of exporting hats from the colonies. There were two things that the colonists excelled in. The other was in the making of cast-iron stoves. The best cast-iron stoves that were exported came from this State. There was a place in Virginia that made a little better grade of hats than they were making in Danbury, so a committee of citizens was appointed to see how they made those hats in Virginia. They found the hat-maker, and they asked him how he did it. "Why," he said, "it is very easy. I just take some wool, and I work it, and I work it, and by and by it is a hat." The hat-maker was a darkey, and they didn't get a great deal of information out of the old darkey, but they came back, and the hat industry has flourished in Danbury

ever since. The best of the hat wool is grown in America, and it is grown in Australia, and it is grown in Spain, and it is grown in different parts of the world. Now, the question comes up, where is it best to get that wool from that we use in the making of hats? It is grown here, why, it is a product of this country. It gives employment to a great many people, etc. It is not necessary for me to go into that matter. I have no design to make a political speech. But reason it right out. Man sits down to think this over. He says we have to have hats, and we can get that wool in this country, and the price is all right. Now a hat has to go through various processes before it comes out a hat. Now, who does this? Why, men and women do this. They have to live in houses. Those houses have to be built. That gives employment to carpenters and painters and masons. People who work in these hat shops can't raise much food outside of what they get in a little garden. I have got to sell them food. I will sell them the food that they eat. Then he turns the hat over and looks inside, and says: There is leather in that hat. Where did that come from? Well, that is leather that was tanned by this man that was on your board, and that you were talking about this morning, that was tanned by Rockwell. Rockwell had to have men to work in his tannery, and these men had to have homes and food to eat, and all that sort of thing. There is a ribbon in that hat. Where was that made? That was made in Hartford. That ribbon is part silk and part wool. The silk came from so-and-so, and the wool came from so-and-so. Man sits down and finds out just how all these processes went through, and then he says, Now, then, all that cost so much when that work is done in this country. It costs so much when it is done in some other country. Now, on that state of facts, am I for free trade or protection? If a farmer will do that honestly and fairly he will settle the whole question.

One man will go over the facts and he will decide that he will buy his hats abroad, and that free trade is the thing for him. He will decide in that way, and be honest in his opinion. Another man says, "I will buy my hats here, and I will pay the market rate, let it cost what it will." He comes to that conclusion, and he also is honest in his opinion. There you have the two sides. That's all there is to it. As a matter of

fact the American hat costs less than any other hat in the world, but I am putting it the other way.

Now, I want farmers to take up and investigate public questions in just that way. Don't take my statement of a thing, or any other man's statement, but take a hat or a boot, or anything you have to buy, and apply the same principle that I have laid down to you, and work it out in your own mind, and you will see what your interest is and what the country's interest is, and decide these questions for yourselves. That is what I mean by a farmer as a citizen. The man who looks at the facts and comes to an honest conclusion about these things in his own mind will not be used by anybody or imposed upon by anybody. Now, there are some public questions that the farmer needs to have his eyes open about in order to prevent a wrong conclusion. Beware of these star-spangled-banner sort of fellows that are going around talking to the farmers, and calling them the bone and sinew of the land, the intelligent farmer, and all that sort of thing. They want to use us in various ways. It is a little pat on the back, with an ulterior purpose back of it. Let me illustrate.

We have been proud as a nation of the great West, the increasing population and development of the great West, but, do you farmers ever stop to think how it was brought about? Now, after the Revolutionary War was over the great question was what to do with the Northwest Territory. Connecticut claimed that the sun set on her territory. You couldn't go so far west but that Connecticut was right there. New York claimed that the Iroquois Indians had conquered the whole country west of the Mississippi. North Carolina had a claim to the territory. She claimed that they had conquered some of the territory that belonged to New York. New Jersey didn't claim anything, for she couldn't. Pennsylvania could not claim anything, for her lines were defined; but Virginia claimed a large part of it. Now, it is not necessary for me to go into the detail of the final outcome of all these conflicting claims. You know the history of the Connecticut Reserve. But as time went on all this vast region was gradually opened up for settlement and development. At the proper time it would have been opened for settlement and development by our own people. What was the proper time? In this thing, if you

please, I think we would have been governed in what you may call a Divine way. The good God made that territory, and he made it fertile. He intended it to be occupied by men who would make the most of it. He hadn't put any peoples upon it except occasional bands of nomadic Indians, and they had no rights there except as they came in and occupied it and drove out the Mound-builders, just the same as the Mound-builders before them had driven out the other Indians. But as the country increased in population, it became necessary for us to use this country, and it was the intention that it should be used and occupied — occupied and developed. It was God's evident intention that those millions of broad acres should be used for the benefit of mankind. There was a constant drift of population from the eastern states that went on and settled the states of Michigan, Ohio, and Illinois, and with the settlement of these states there began to grow great schemes. Schemes for railroads. There was no more use for a railroad west of the Mississippi River than there was one to the moon. There was nobody there to use a railway, but schemes for the construction of railways were put in force. Railroad grants were obtained from Congress of alternate sections of land running through that great territory. What did they want that land for? What did they want their charters for? Simply so that in the future they might make money out of it. What did they do? They went to Europe, and Europe had been land-hungry for centuries. The land of Europe is owned by a very few men, and all the rest that had a hungering for homes of their own and desirous all their lives to own land, saw no opportunity to gratify their wish except through this new opportunity that was opened to them. These schemers made arrangements with transportation companies in Europe, and arrangements with transportation companies across the Atlantic, and arrangements for transportation from the Atlantic ports to the west, and then they brought men and women from the center of Europe and put them down on these alternate sections of land in the great west. And the schemers said to the people of the east, We will sell you homes cheap, or you can take up land under the government act, and we will sell you a ticket from New York to go out there. These people had been engaged in various occupations, and so they scraped together whatever they could and went out there, and settled upon this

land, and soon they were sending into the markets provisions and grains to compete with us of the east. That is the way that country has been largely settled. That process has been going steadily on until the great West has been practically populated. What has been the result? The result has been the depreciation of agriculture that we have been moaning and complaining about all these years. The enormous products of the west, and the cheap transportation of the same has made it impossible for us to compete with them, and our land has depreciated in value. I have gone into something of the figures, but I am not going to give you figures at this time. I have gone into an estimate of the depreciation in agriculture in the eastern states, these states bordering on the Atlantic Ocean, and also the increase of the value of land west of the Mississippi River, and do you know that there is a dollar of depreciation in the east for every dollar of increased valuation in the west. Three-fourths of all that result has come from this forced and abnormal development of the country under the schemes of these men who obtained these grants from your representatives and mine. We have given away this heritage, and we have brought the people of Italy and of Poland and of Scandinavia, — people that had no claim on us in any way in the world, — brought them over here and put them down in this garden spot to compete with us in the markets of the world. I tell you for every dollar of increased valuation in these states west of the Mississippi River, you have got a corresponding decrease here out of your pocket and mine, and the country is not any richer for it. I don't care what they may say. Now, farmers ought to examine these things for themselves. However, that is all past. That is not a question for the future, but there are questions for the future akin to this.

That great tract in the center of our continent, which used to be called on the map " The Great American Desert," is now New Mexico, Arizona, parts of Colorado, and parts of Utah. Without water it is as barren as this floor, but with water it is among the most fertile of all the lands of the globe. I never saw anything in the richest part of the world superior to it. I never saw anything in Australia or Asia, or in any part of Europe equal to the fertility of the soil of Arizona when irrigated and properly watered. Those are public lands belonging to you and to me. Now, there are great schemes afoot

for the United States government to take your money and mine, for the money raised by taxes belongs to us, and build enormous irrigation works out there to take the melted snows from the Rocky Mountains, impound the waters and irrigate hundreds and thousands of square miles, and make them blossom like the rose. Beautiful scheme, isn't it? There is that wonderful country belonging to us, of marvelous fertility, and all that is required to make it blossom is simply to turn on the water. The promoters of these schemes know that when they turn on the water the people will come. They are after the farmers to help them in the promotion of these things. They had a Congress up in Boston the other day. I had the honor of being invited. Well, I knew about a convention of this kind that they had down in Texas, and I knew what was afoot. And when they had this meeting in Boston they had it all cut and dried to derive money through getting up a petition to present to the Congress of the United States to make an appropriation of so many millions of dollars to develop these irrigation schemes. What does that mean? That means they are going to take your money and mine out of the treasury to build these irrigation works so as to make these lands productive of crops, increase our competition, and knock the value out of your land and mine.

Now, then, the farmer who is an intelligent citizen will examine all these things for himself, and protect himself from the schemes of these men who would work his ruin. Protect your interests, and see to it that at the same time you are serving the true interests of the country. Now, it is not necessary for me to go on in that line further. I have told you that I think the farmer should examine these questions for himself, come to a decision about them, and then have the courage of his convictions, and stand up for what he thinks is right.

The Farmer in Social Life. The home is the initial point. The home is the starting point of society, and social life depends upon home life. Social life in America depends on the life in the homes of America. In France they have no word for home in the French language. Social life depends, therefore, upon the concert room, the café, the seat on the sidewalk, or in the gardens, or the settee in the park. People meet in that way. There is no home life there in the sense in which we have it. Home is a temporary abiding-place; and it is not what we

call home. In this country the home is the basis. Now, how will I speak to you about what the farmer's home should be? I do not know of any better way than to begin with the relation of parent and child. The farmer's home will be attractive and interesting according as the parents make it interesting for their children. The farmer, too often busy with his affairs, pressed for time with all the things he has to attend to, has no time for his children. It is the greatest mistake imaginable. I don't care about the crops in the fields, I don't care about the crops in the orchards, the most valuable crop that was ever raised on this earth is the crop of children in these houses and homes. Let the orchards and the fields go uncultivated, if necessary, and attend to the children in your home. Make the children interested in your interests. No intelligent father can be a father in the truest sense of the word unless his children's interests are his interests. Take an interest in their games, their manner of play, and interest them in everything that you are engaged in. The child delights to be with you. If a father goes fishing with his boy occasionally, it makes no difference if he does take a little time to do it. His pleasure ought to be your pleasure. Conduct things on that plan, and what do you find? You will find that the companion that your boy most delights in is yourself. He is yourself. It is according to nature. It is according to what you will find in your experience. If you will give your children some of your time and thought, and make an effort to take an interest in their affairs you will find that you are the companion they most desire above all others, but you must be wide awake, and you must interest them in everything that is going on. In such a family, social life is always bright and attractive. The farmer has an opportunity for interesting and developing his children that no other man has. No other man has such an opportunity. Take the animals upon the farm, for example. The farmer should give his boys to understand how the animals have been improved. He can tell them that you can go back to the remotest antiquity and still man had domestic animals. We do not know when man began to domesticate animals. We do not know anything about it. Man and animals seem to have existed here upon the earth co-incidentally. We do not know how long before the time we find them together man began to use them, and we do not know how long after he

began to use them it was before they were domesticated. We go back to remote antiquity; we go back thousands of years, and we find the remains and the bones of our domestic animals with man as we do to-day. We go back earlier to the carbon age, the stone age; we go back to that remote age when man had nothing but the rudest stone implements, and there are the bones of domestic animals; our animals of to-day. Tell the boy this, and the child's mind at once is interested in these facts about domestic animals. Then as you go along later on tell them how they were reproduced by haphazard methods, and that it is only within a century that scientific breeding began. In the time of Henry VIII. there had never been such a thing attempted before. The earliest improvement we know anything about is in fowls, the fruitfulness and fecundity of which has been increased, from whereas in a natural state the bird laid only from fourteen to fifteen eggs a year, to no less than one hundred and fifty to two hundred eggs in a year. In domestic animals the first serious attempt at scientific breeding was made by Mr. Robert Bakewell in England. I made a pilgrimage to his house. He was the man, the first in the world, to begin scientific breeding. Tell your boys about this, and how improvements have been made in different breeds of cattle, and how they have been brought up to the standard which he sees established. The child will become interested, and he will see how the forces of heredity operate upon our domestic animals. Also the influences of conditions and environment. The farmer who teaches his boy these matters in regard to domestic animals, rouses the interest of that boy, and when he gets these ideas into his head he wants to improve. Gradually he gets this idea of natural selection. He sees what men have accomplished in the past, and you rouse in him an ambition to take part in the work of improvement. Then show him that there is a tendency to revert. We do not know what the original cow was. But we know that there are the Chillingham breed in England which are said to represent the lowest type of cattle we know anything about. Then tell the boys that a vessel was wrecked in the Pacific, and the cattle went to an island, and nobody knew anything about them for over seventy years, when they were found there. When they were found they had lost their former type, and they had reverted until the majority

of them were almost identical with the Chillingham cattle of England. They all became white, with brown ears and brown eyes. One of the most wonderful things in natural history is this reversion to the original type. Teach your boys this principle of reversion according to the laws of nature. And how, on the other hand, the longer you select and improve the stronger becomes the breed and the easier to hold it to a high standard.

So with vegetation. Over there on the table on the side of the hall there are samples of corn. That variety of corn has been raised on the same farm since, you say, 1757. I believe it because I am in the State of Connecticut, the land of steady habits. There is a gentleman in the audience who told me last night that there was once quite a controversy between Rhode Island and Connecticut, and the Rhode Island man, in talking about it, said: "You know what the people of Connecticut are, but the people of Rhode Island are honest." Being in Connecticut, I believe it has been raised on that farm continuously since 1757. Now, you take a boy, and you take corn, for instance, and you say to him, "John, do you know that nobody knows how long people have been growing corn? We don't know how long man has been using corn. We don't know anything about it, but the greatest argument to show the antiquity of a man is the corn plant. Now, remember that, John. The strongest argument to show the antiquity of man is corn." Tell him how it is. We do not know how long man lived with corn growing here in a wild state before he found out that that stuff was good to eat. Centuries elapsed very likely before he found out that he could make use of it. After he found out that this wild grass was good to eat, we do not know how long it was before he found out that he could cultivate it. For centuries probably he ate it in a wild state, but after he began to plant it, he then began to select and improve it until he so changed the type of the plant—and that is a very slow process — he so changed the type of the plant that the botanists themselves do not know what the original plant was. Nobody living knows. That has been going on through a course of centuries almost incalculable. Then, show how, by selection, you can improve corn. You can greatly increase the product or yield of corn. Go on in this way, and you get the idea into that boy's mind that he is working in partnership

with God; that he is working in harmony with nature. Now, that is enough on that point. Then, you have got intelligence. I am speaking of this simply as the basis of social life — simply as illustrating the relationship and the companionship which should exist between father and son. I am speaking of it simply to illustrate the basis of social life, and not of its value to the boy, if he is going to be a farmer, but of its interests to him as an incident in the household. Interest yourself in the things that the child takes an interest in, and make him interested in the things that you are interested in. See that he brings into the house interesting things; things that will excite inquiry and cause your children to inquire and investigate. Then when you have made your children interested you can invite some company to the house, and they will have a good time. You invite company to the house where the children haven't anything to be interested in, and that company is going to have a poor time. If they are intelligent people, they are not going to enjoy their visit to your house. You may turn the whole establishment upside down, and get for them every foolish thing you can think of, and get up for them the best dinner you can give them, and give them the best room,— you can do everything in the world, but they will not have a good time. But, if company comes to your house, and your children are chock full of interesting things and intelligence, they will go away pleased, and will say, That is the most interesting family I was ever in in my life. I know what I am talking about. It is the children that make the type of a home. The single as well as the married children.

Now, about this matter of having company come to the house. If there is any one thing that I would beg of a farmer's wife to do when she has company come, it is that she should not make a fuss over them. Were you ever so uncomfortable as when you went to a house, and your visit upset the whole thing? Where they gave up their occupations and things that they were going to do, and got up and made a great effort for your entertainment, and the poor woman of the house slaved all day to get up an extra dinner for you, and you were put in the very best room in the house, and your host and his wife slept in a little place around behind — and you want to get away from such a place. That's all there is to it, you want to get away. But suppose, on the other hand, you go to a

farmer's house, and he comes out to meet you, and he says, "Hello! I am glad you have come, I am going to do so-and-so. Come along with me, and we will talk." And you leave your wife in the house and go with him. They do their work in the house, and everything goes along naturally and orderly. And when dinner time comes you go in and have just what they were to have, no matter whether you had come or not. Mr. Hale told me about a man down in Georgia who, one day, when it got to be about noon, said to him: "Look here, you can't get home to dinner, come home with me and have some. I don't know anything about what you will have, but I'll tell you one thing, what you do have will be good, because the way the Missus serves it." Probably it was hog and hominy. I know what they have, for I have been down there. Now, that is the way I like to hear a man talk. Never make an apology for anything that is on the table, for heaven's sake. Serve what you have got to serve, and serve it as though it was the best thing under heaven, and say nothing about it. Everybody will enjoy it. Then, there is another thing. You and your wife always occupy the best room in the house. There is no room in the house too good for you. Never serve the best room for me if I come to visit you. You want me to have a good time. You are hospitable, and you want me to have a good time. If you do, you occupy the best room, and let me have some other room. Let the children have the next best room. What difference does it make where you sleep? You occupy the best room in the house and let the children have the next best room, and when your company comes, say, Come right in, I am glad to see you. We have got some pork and potatoes, but, come along, come right in. Never apologize for anything of the kind. And you will find that the next time they come around they will come to your house, because they know it will not be any trouble. Why, you will have twice as many, if you meet your guests in that pleasant, social way, and they know that they will have to take you just as they find you. I despise this constrained and awkward, unnatural and foolish way of treating guests. The style has changed. Years ago the guest-room was the best room in the house. But don't have a room in the house that is too good to use every day. What is the use of having things if you cannot use them? I wouldn't have anything that was too good to use. The thing that is

too good to use is not good for anything. Now, a home that is built on the lines that I have indicated in reference to children, I believe you will find to be a happy home, and the social life that goes on about it will be charming and pleasant unless there is something radically wrong somewhere.

Now, there is one thing that I have not said anything about. I have not said anything about the wives. I tell my wife every day she is just four times as young that day as when we were married. Praise your wife. It don't do any harm anyway. Very often it is true when you say it. Now, you do not need to have anything more said about the social side of the question. Society is all right. If you carry into practice the principles that I have described you will have all the social intercourse that you can possibly attend to, and it will be enjoyable. It will be edifying. Your visitors will come and stay all summer. And when you meet them afterwards they will shake hands with you, and say, " I have been to your house, and I tell you what it is, you are my sort. I like your fashion of man."

If the farmer as a citizen takes this interest in the social side of the question, based upon a home such as I have described, he becomes a power for good in the community, the state, the nation. He becomes a power for accomplishing the best purposes of the community and the nation at large. He can make himself felt as a man can in no other way, because such a man living up to the height of these principles develops all there is in a man. There is nothing that will develop a man like this sort of relationship. It enlarges his thought, his soul, and his mind. He takes broader views of things, and he gets in closer touch with the community. He is more of a man, and he is better able to accomplish God's purposes for him here upon the earth.

Governor LOUNSBURY. It does not seem to me that the last speaker has left very much unsaid, but, perhaps, there are some of you who would like to say something in regard to the subject, and we certainly would be very glad to hear from anyone. Perhaps there are some questions in the box.

Secretary GOLD. Yes, sir; there are. It has been my privilege to visit the home of our last speaker. Some half

dozen of us were quartered on him one night. There was ample room for all, and a double abundance of everything, and the children were happy and free about the house. I remember with the highest pleasure the hospitality of that home. Any others who have been there I think will agree with me that it is one of the hospitable homes of America, where these principles that we have heard are illustrated, and carried out in the fullest degree. It was characterized by open-handed, free hospitality, and where the children were not in the way, but were all the time about where they should be. A child may sometimes be in the way. I visited a place once where the next morning the boy of the house got into my room and got hold of my satchel, and was investigating it before I got out of bed. I found that all the cane-seated chairs had been put away, and some board-bottomed chairs were used in the rooms below, and they told me that the children punched holes in the seats, and they had to put the chairs away, and the father said: "It is about as much trouble to raise up and break a boy as it is a pair of steers, anyway." Now, if he had spent half the time on his boys that he spent on his steers, what a change there would have been in that family home! I am afraid that there are too many farmers that will come into that category of the man who spent more time in breaking his steers than he did in the training of his children. But I hope those days are going by. We know better than to do things in that way now. The children should learn to come to their parents. The boys to the father and the girls to the mother for their amusements and for their instruction, rather than that the mother should have to run after the girls, and the father after his boys. What is more pitiful than to see that in a family? Now, bear in mind these principles that have been laid down here, and make your homes the centers of happiness and power in the land. Good government of the children and in the home means good government as citizens. That naturally follows from obedience in the family.

Mr. HALE. Just one word. I have been particularly interested in the remarks of Col. Wood, and especially in his closing remarks about the home and home life. I wish that could have been repeated two or three times over so that it might have been impressed upon us all more strongly. We all of us know that there is too much of hard work upon the small farms of New England, and that we are inclined to live a little too much in the back side of the house and not utilize the best we have but save it up for our guests. I believe the best way is to enjoy what you have, and leave the less desirable portions for occasional guests. I believe it is the right and proper plan. I am glad that Col. Wood has said that here. I wish that it might be strongly impressed upon us all that that is really the right way to live, and it is really a sort of mark of respect to our guests. And I want to endorse Col. Wood's remarks in relation to our public officials, and all our friends. It does not hurt anybody to pat them on the back and tell them when they have done well. It is the proper thing to do. If a man is working for you and he does his work well, tell him so. It does him good. He will do better work, and you will get better service out of him. Now, I want to ask the colonel a question. If the average employe in our business upon the farm and in the home does well, to what extent should they be praised or encouraged? Many of them are not of a high grade of intelligence. I have been doing that to some extent, but, if you go too far, pretty soon their value to you is gone. They are rather inclined to get a big head, and think you cannot get along without them, and you almost have to withhold the proper notice that you would like to give, because in a short time, if you do it, they become important, and you have got to tell them to move on. What are you going to do about that? Will you withhold it, or give it in every instance where it is deserved, and take the consequences?

Col. WOOD. I am glad Mr. Hale has brought that up. It is a matter I find no difficulty in at all. There are different

ways of doing things. I have been in the practice for a good many years of always commending my men, and have had no big heads resulting from it. If I show them that I am well satisfied and pleased with what they have done, I try to do it in a perfectly natural and spontaneous way. If there is anything unnatural or forced about it, a man will say, " Hello, he has got an axe to grind. He is praising me for some ulterior purpose." And it would have no good effect. But if you say to your man, " John, you have done a good piece of work there. That is a good job," do it in a sort of an off-hand way. " You have got done with this job sooner than I expected. I thought it would take a day longer to do this." But, always when I refer to it I try to do it in a natural and spontaneous way. The dullest man sees as quick as a flash whether the thing is natural or spontaneous, or whether it is constrained and awkward. Men are very much like animals in recognizing a thing of this sort. The mule is quicker than a flash to see whether you do a thing in the natural and right way, but if you do it awkwardly he will kick you. And, just so, you take people of rather inferior intelligence, and if you commend them in a natural, simple way it will not do any harm, but if you do it with an effort, or in any way other than a spontaneous, natural, easy, off-hand way, they will suspect that you have some ulterior purpose, and you fail to get any good result from it. Another thing, be perfectly frank with your employes, and do it in a simple, natural way. If a man does a thing which does not suit you, tell him of it, and then just let it go. He will do it a little better the next time. The best service you can get from a man or woman in your employ is that service which springs from a knowledge on their part that you appreciate it when they do well. Do not indulge in coarse criticism, but simply say, " This ought to have been done so-and-so. I am rather surprised that you did not know how this should be done." Then leave it. Be perfectly frank in your criticism in that way. Express your disappointment when a thing is not well done, and

express your pleasure when a thing is well done, and you will get better service out of your men than you can get in any other way, and it will do no injury to anyone.

Secretary GOLD. The idea expressed in another form is that there is a great deal of human nature in humanity of all kinds and grades. There is just as much human nature in these somewhat ignorant, untidy people, and in children, as there is in grown folks and people of better training.

Here are some questions in the box that demand our attention. Here is a question that Col. Wood has been discussing. Perhaps we do not need to have anything more on that, but I will read it. "Is it for the best interests of the nation, as a whole, that the Government undertake the erection of irrigating plants?" I made up my mind quite a while ago on that question. I think it is not. Has anyone a word to say on that question?

Mr. HALE. It is the work of the individual citizens and states in the west. It is possibly a necessity that these works should be built, but I think it is entirely a state matter. I do not think that the national government should put a dollar into it.

Secretary GOLD reads: "If a cow while springing develops a caked quarter, should she be milked out and treated before coming in?"

Dr. CRESSY. Why, I think it would be well enough to do so. It certainly would not do any harm, and it might do good.

Mr. PLATTS. In the only experience I have had I have found that about the best thing is to let it alone, but there is once in a while a case where there seems to be inflammation, that a little work upon the udder would be well put in. As a general thing, in nine cases out of ten, the best treatment is to let it alone.

Secretary GOLD reads: "Is the money expended for the

liberal education of the boys and girls who remain upon the farm money wasted?"

Mr. JAMES TUFTS. That depends upon the boys and girls. If they are good for anything, and they stay on the farm, whatever education they get will help them, but I have seen farmers do well with but little education so far as the schools are concerned. They educated themselves as they went along. An education obtained in the high schools and colleges helps if the boys and girls are good material and know how to use it well. If they are lazy and inefficient, going to the high school or college is not going to help them anyway. A good many have an idea that if they can get an education it will help them along so they will not have to work. That kind of an education will not help them any if it gives them the idea that they can get along without work. It will simply make fools of them, and they will come to nothing, as a great many do.

Secretary GOLD. Mr. Tufts has expressed the right idea in my judgment. If a fellow has not got any stuff in him, going to college is not going to make much of a farmer out of him. It is plain enough to us that the period of youth should be spent in a good degree in the development, not only of the physical, but of the moral and mental powers, and I believe in that way that an education adapted to the farm, or adapted to any other employment in life, is due to the individual. Parents and the State hold these opportunities open to everybody. That is the theory of our compulsory system of education. I do not know just how far that should be carried, but that principle implies that the State holds these opportunities of education open to every one of its citizens, so that they may be more effective, more virtuous, more skillful, and more successful in all their duties as citizens, whatever their position in life may be.

Mr. HEDGES. Some time ago, Mr. Chairman, two or three of us at home were talking about a graduate of Yale College who did not seem to turn out very well. He seemed to be lack-

ing in common sense, and lacking in judgment. And, after talking all around the subject, one of the company said, " I think," says he, " that the learned fool is the biggest fool of all."

Mr. HADWEN. Mr. Chairman, while I believe the education of a man who follows agriculture or horticulture should equal the education of a man who follows other pursuits, still I believe also in the old English rule of six months in school, and six months in the field. I believe the application of that rule has made the smartest and best men any country ever produced. The fact is, in our colleges and schools, we have tried to get too much information from books and too little from natural objects. The discoveries of the world were not obtained from books. Franklin got information from a kite. Agassiz got his information from the fins of fishes and the wings of birds. Therefore, what seems to me to be the best course of education for farmers' sons is that they should first be educated in the schools and colleges, but at the same time they should not neglect the field. I think that is one of the important things in farm life. There is a great deal, of course, to be said upon this question, and a great deal that people do not generally agree to, but the best farmers I have ever seen or known are those who have spent a great deal of their time in the fields.

Secretary GOLD reads: " What variety of apple is best to graft on a Ben Davis four years old? " We have got two or three facts to consider in this question. One is that it is a Ben Davis tree that you are going to graft, and then the questioner wants to know what the best apple is to graft into it. That depends upon what he is going to do with the apple. If he wants a Sweet Bough let him graft that into his tree, or if he wants a fall apple there are the Gravenstein, and the McClellan, and a host of others. If a market apple is wanted, and an apple easily harvested, to put in the Baldwin is about as good as anything. We have not yet got so familiar with the Sutton Beauty as to say that they will bear out all the endorsements we hear of that variety. Perhaps we shall get to that, but, so far, we

have no evidence that is generally accepted that there is any apple in our New England climate that will produce more abundantly and early from grafting, and bear handling and conveyance to market, and sell at a better average than the Baldwin.

Mr. HINMAN. Mr. Chairman: I do not know as it makes so much difference what you graft with, but a conscientious farmer who has got a Ben Davis apple tree ought to graft it.

Mr. HOYT. If the man that asked that question wants a good family apple, and he has got no other tree to graft into, let him put in the Rhode Island Greening. Perhaps that question was asked with the idea of whether he could graft an early apple upon a Ben Davis. After what was said yesterday, perhaps, he wanted to know whether he could graft an early apple upon it, or whether he should have to graft a winter apple because of the stock. I should say to graft just what he wants. What variety he puts in there will be that variety upon a Ben Davis just as well as upon any other.

Secretary GOLD reads: "Should ensilage corn be planted so as to produce a full amount of ears, or a large amount of stalks without ears?"

Mr. CHAMBERLAIN. In my judgment there is only one safe answer to such a question as that, because the value of the corn plant is in the mature plant. If we plant for any other purpose we plant at a loss. We cannot afford to grow anything that is inferior to something else at the same cost. Therefore, in growing for the silo I think we should grow as carefully and as thoroughly for the grain as for the stalk. I think there is no safe solution of the question short of that.

Mr. STANLEY. Some years ago when Mr. Stewart was living he held the opinion that the corn plant was at its best when it was in the silk, and before the corn was formed on the ear. He held that where the corn matured so that it formed the ears, coming to the milk stage, as we say now, that that was a detriment to the ensilage. The experiment stations took

hold of the matter, and I believe that their investigations were based entirely upon the chemical analysis of the plant; this showed more dry matter, and more digestible matter in certain elements in the mature corn. And, consequently, they argued that the corn plant should come to a certain stage of maturity before it was cut and put into the silo. Now, everybody that has fed mature corn cut up and put into the silo knows that a large amount of the corn passes through the cow undigested. What the proportion is I do not know, and I do not know as anyone can estimate, but it has been brought up during the past year for argument, and I read a statement from one man who claimed pretty positively that all the mature corn that is fed out of a silo to a cow is so much corn thrown away, and he holds that the same amount of corn ground up as meal would make a great addition in the result, or in the productiveness of the cow. I think that is a point that ought to be settled. I think if the experiment stations would take hold of it from a practical standpoint, the farmers could settle it. Possibly some such experiment as this would help the matter. Plant a part of a certain field in such a way as to produce an abundance of ears, and another part of the field in such a way as to produce a greater amount of stalks, and let the crop mature, and then cut both and put into the silo, and then when you feed it, watch and see if there is any difference in the quantity or quality of the milk which can only come from the silage. Of course it would have to be separate in order to tell much about it. A great many argue, or advise, the plucking of the ear, and putting only the stalks in the silo. I have tried that, but have had no success. More than that, the corn cannot be ground. If you pull the ears off when the corn is in the proper stage to be put into the silo they shrivel and shrink so there is practically nothing left but the cob, and that is often so green that it does not dry out, and when you come to grind it it makes a wet, sticky mass. I should like to see it tried quite thoroughly another summer. I made an attempt

last year to try it by pulling the ears off, and then feeding it right along without changing the rest of the food, but as luck would have it when I came to that corn which had the ears pulled off we fell short of water, and we naturally had a drop in the yield of milk, and so I could not tell whether it was due to the shortage of water or to the shortage on the corn in the ensilage. I think another summer, possibly, we will not be short of water, and I can then tell more definitely whether it affects the yield of milk materially or not.

Mr. PLATTS. I have been really interested in the question under discussion, and the passing of the whole corn through the animal has puzzled me sometimes to know where the true economy lay. I have done as well as I could by simply cleaning my stable into the pen where the hogs are kept, and I think I have made some saving in that direction. I only wish that the experiment station could make a careful investigation of the amount of undigested food passed in that way. I know that we have better silage with reasonably well ripened corn, and the only question is the weight of whole corn passing the animal. I have saved that to a certain extent, and so far it is the only way I think we can do it.

Prof. PHELPS. I think there has been quite a little progress along the line of this question since Mr. Stewart wrote as referred to by the previous speaker, and I think the experiment stations in their investigations have generally come to the conclusion that the largest amount of nutritive material is found in the corn when it is well ripened — taking the green ear and stalks together. But further than that: if the food at that time is of the greatest value, there is still another question affecting the ensilage side, and that is whether the corn should be allowed to become so thoroughly matured as to allow a certain proportion to pass the animal undigested. There has not been much experimental work on that line. There is Prof. Henry's recent book on feeding, where the amount of undigested food in the excrement was determined, both from the dry ear corn,

and also from the ears in the silo. And in the case of the ensilage corn which was picked out it was found that there was only three per cent. undigested, while in the case of the dry ear corn eighteen per cent. That, however, does not settle the question entirely, because there is no record of just the stage of maturity of the corn in the ensilage. There is a question which, as yet, is still unsettled, and that is, what degree of maturity we should allow ensilage corn to reach in order to have it prove of the highest value to the animal and result in the smallest amount of loss of undigested material. I think in the next few years there will be some work done on that line. I am rather of the opinion myself that where the corn remains soft, or where there is a considerable amount of moisture in the ensilage, but very little of it passes the animal in an undigested condition.

Mr. HOYT. I was going to say, Mr. Chairman, that the answer to that question was this: Judging from my standpoint of experience it is better to plant your corn thicker. The object of your silo is largely to give your cows succulent food and bulky food. If you plant your corn at a distance you do it at a loss of bulk of material to fill your silo. I believe that corn with the ear would be worth more to mature and grind it up and feed to your cows rather than to put it into the silo. If you put in your corn ears your bulk is not increased materially. You may think it is increased some in quality, but do you get the proper ration that you want for your cows? Do you not want to give them some other nutritious food which would be better to add to the ensilage than corn? My impression is that it is better to plant the corn thicker and get a larger quantity of corn to put into the silo, and bring up its quality with cotton seed meal, wheat, bran, or something of that kind.

Secretary GOLD. Having noticed this matter of undigested corn, and as this year we had our ensilage planted in three or four fields, one of which eared abundantly, we left this field for the last. We had a field with pigs in right alongside,

some forty shoats that we wanted to feed with corn, so we picked off the ears and dropped them on the ground in rows or heaps. There might have been 150 bushels of ears per acre. Then, every day we drove in with a team after the ensilage was cut and drew a load of the ears into the pig lot. We scattered them around, and they lasted the pigs quite a long while, and they seemed to enjoy that food and thrive on it. I believe there was something saved in this way rather than to put our over ripe corn into the silo. It ripened very rapidly this year. I think we did better to snap if off and feed in the husk. I should not want to go through the labor of having to husk it. Men do not work nights husking corn as they used to. I think we have got a good deal to learn about the best condition possible for our ensilage, and how thick we should grow it.

Here is a question about sweet corn. "Can the amount of sugar in sweet corn be increased by certain fertilizers?" Is there any evidence that the use of certain fertilizers affects the quality of sweet corn?

Prof. PHELPS. Judging from analogy there is no reason why it ought not to be so, but if it is so I do not know that there is any experimental data to show it. We know, however, that the percentage of sugar in the sugar beet has been increased by the use of certain fertilizers. We know that the percentage of sugar in the grape has been increased by the use of certain fertilizers, and judging from analogy the same thing ought to be true with regard to sweet corn, but I do not know of any experimental data which tends to show that that is the case.

Secretary GOLD. We are informed that the climate and soil of Maine is particularly suitable for producing the best quality of sweet corn. The canning industry there has thrived to a remarkable degree, and they claim that the corn raised in that climate is better than that raised further south. It is said that formerly when the people in the southern part of the

State wanted to get some real nice sweet corn to plant, they got it from their friends up in Litchfield County. Now, the east buys very largely from California. Experience shows that on the hills sweet corn matures slowly, and it rarely gets too dry and hard before frost comes. That is the way it used to be. Now, in order to have a supply we have to make a planting of three or four varieties, because they mature so quickly and pass on. I think probably Prof. Phelps is right, and we should expect that the application of a proper fertilizer would influence the full development of a variety.

This matter of the location where seeds are raised is such a curious and interesting one that we might spend a whole day discussing that subject. I only call attention to it. It is remarkable the profusion with which some varieties seed in California, enabling the producers of seeds there to supply our seedsmen here with seed that are raised there, and those seed go to other places and other parts of the country as Connecticut seed, because our seeds have such a reputation. They bring them here, where they are re-packed, and go out as Connecticut seed.

These matters in regard to seeds have come to my knowledge by conversations with various producers of garden truck, seed producers, flower cultivators, and so on.

Mr. HADWEN. My own view on this subject of seeds is that the seed should be used in the state where it is raised as far as possible. The climatic conditions under which seeds are raised should be taken into consideration. I know it affects trees. I do not know why it should not affect other plants. I have no positive information in regard to it.

Mr. IVES. I have been in a good many of the different states and territories, and talked with a great many farmers about the seed that they have planted. I was in Kansas some twenty years ago. In the early days of wheat raising out there I recollect being in the city of Wichita, and the people would come in there with reports of their wheat, reports as to their crops, and what they produced to the acre.

Once or twice I happened to be in when men came in with seed from the agricultural department. They had measured the ground that they raised that wheat on, and it showed that they had a larger yield and a much better quality of wheat than they got from seed sown and raised in Kansas. I called their attention to it, and asked why it was that the seed which came from a long distance away was the best? I asked why it was that the seed coming from an entirely different soil, and raised under entirely different conditions from the wheat that the other people brought in, was the best? I told them that that same wheat raised for five years in Kansas would not raise any more to the acre than the seed which had been raised in Kansas right along.

I used to drive cattle from Vermont, and we used to raise some wheat around here. I saw that up in the neighborhood of Brattleboro they had a good deal better yield than we did here, and I got them to send me down some of that wheat, and I sowed an acre or two of it. I had no trouble in raising twenty-five or thirty bushels to the acre as fine wheat as you ever saw grow, and I got $3 a bushel for it. Everybody succeeded in growing it in the same way until they run it out. You want to change your seed.

Secretary GOLD. There has been a good deal of difficulty with sweet pea seed. I was told that "if you have got any old sweet pea seed sow that, and do not buy any new sweet pea seed this year." I had found trouble with buying this fancy seed. It came up with but a feeble growth of stem, and then the whole thing went back. So far as sweet peas are concerned, the first failure I had from my boyhood up was in trying to raise a crop from some of this fancy seed. This year I planted a lot of old seed that had lain for two or three years, and supposed it to be almost destitute of vitality, but I sowed that seed, quite a number of varieties, and I had as fine and abundant growth of vine and bloom as I ever had. Perhaps Mr. Hadwen can tell us something about it.

Mr. HADWEN. That confirms a discussion which I heard in relation to that matter by some gentlemen who had sown sweet pea seed that came from California, and who also sowed some sweet pea seed raised about here, and while the California peas were a failure the sweet pea seed raised in this section was all right and vigorous. I heard that discussion in our horticultural society meeting. That is about all I know in relation to it.

Mr. PLATTS. The question of the seed which a farmer shall use is, of course, a vital one. I know of no better rule than to get your seed from those farms or those localities where the product is raised largely, and with the greatest success. Now, in regard to corn. We are near the center of the best corn-raising district, and with proper selection we ought to have no difficulty in getting good seed. I do not believe in planting poor seed of any kind. I believe with proper selection we need not go away from Connecticut for seed with which to raise the best crops our soil is capable of. I have some reason to believe that the same may be the case with potatoes. An acquaintance of mine is raising Early Rose potatoes to-day. He was the first farmer that raised them in that locality, and I do not believe that there are finer potatoes raised in the State to-day than are raised by that man, and part of the secret of his success is that he never plants poor seed. I believe that right here where we are, near the center of the corn-raising district, and for raising small grains, with the possible exception of wheat, we can do just as well as other localities, and, in some respects, better. I know that they can average heavier crops at the north than we can here, but I do not believe there is a region where better wheat, or larger crops of rye can be raised that can be raised here in Connecticut, if the seed is only selected properly and nothing but the best seed planted. Of course I do not mean that we can compete with the west in grains, for none of us carry on farming on a large enough scale to afford to use modern tools for large farming. We

cannot afford reapers and mowers and all those things in the limited area which we cultivate. It is useless to try to compete without the use of machinery such as they use in the west, but we can grow the crops here. The last crop of wheat that I raised, and I have raised a good many in my life, yielded forty bushels to the acre. I do not believe that we need to go anywhere for seed if we only sow the best.

Mr. HALE. It has been my good fortune at occasional times to meet with a number of the most intelligent seedsmen of America, and this question of seeding was up one evening, and it seemed to be the general consensus of opinion by a number of the best informed men present that the northernmost limit where a plant came to perfection was the place to get the seed. The old seedsmen found that they got the strongest and most vigorous seed from those plants that came from the northernmost limit where that plant grew and came to perfection. It set me thinking. In recent years I have tested it some, and I have come to the opinion that those gentlemen were right, and that at the northernmost limits that any plant will grow to its full perfection, there you will get the best seeds.

Secretary GOLD. Over on that table is an illustration of what is done in onion culture in Connecticut. Our onion-raisers in Connecticut that have made such a success of it are putting into the New York market a fine, white, globe-shaped onion that is standing the competition of that market, and our onion men are getting their own prices, and they would not trust to any seed that they could buy in the market.

Mr. FANTON. Mr. Secretary, I do not agree with some of the ideas about buying seed. I have grown onions on the farm where I am now for about sixteen years. When I started I got seed from my father, and I think I have improved the strain of onions during those sixteen years, so that to-day I have a better onion, a better shaped and more marketable onion, an onion that is more sure of bringing a good, strong price,

and it has been done by selecting the best onions every year for seed. Up to last year I always had my own seed, but a year ago I lost all my seed by a hail storm, and so last year I bought my seed in Milford. Part of that seed was from onions that I had sold, and that were not selected. What I mean is, the party took the onions as they grew. When I speak of selected onions I mean onions that are perfect in shape, with a good root-end and tip. Those onions that are picked out when they are topped, and after that they are selected again. If there is an onion that does not look right, that is a little off in color, or a little out of shape, we do not save it for seed. I believe if we are getting a better onion to-day it has come because there has been a careful selection of our seed stock.

I think, in speaking of potatoes, that it is necessary to do the same thing. I have not had as much experience with raising potatoes as I have in onions, but I think, possibly, where there has been a great mistake made is in planting potatoes as seed, which are just as they come, and without careful selection. I believe we can improve the strain of potatoes if we use those for seed which have been carefully selected. I think the majority of farmers, perhaps, use for seed potatoes those that they cannot sell. I believe if you plant anything it should be the best, and it does not make any difference whether it's onions, or potatoes, or flowers, or anything else that we raise.

Mr. Hoyt. You know, Mr. Chairman, talk is cheap. It is easy for some people to talk well. People's seed is the best who have got it to sell. My opinion is, that you want to get the seed that is the best, and I don't care whether it is raised in Connecticut, or where it is raised. If I can get better onion seed from my friend here than my own I would send to him, or if I could get better seed in the west I would get it there. Men have traveled all over this country from western New York, and they tell you that trees grown north are better than those grown here in Connecticut, and I will take those trees because they come from the north, which is an argument to sell

stock. What we want is to get a good thing. I do not care whether a tree is raised in Connecticut or western New York, if it is a good tree we want it. It is just so with potatoes. I just as leave have seed from my neighbor's field as from Vermont. I do not believe the location where it is grown has much to do with it. I believe that a tree grown here in Connecticut is just as good as one grown to the north. It is just so with seed. What we want is good seed. There is something very singular about this seed business. Take a potato. What constitutes a good seed potato? Is it a large potato, or is it a small one? There are lots of places where a small potato gives a yield equal to a large one. You cannot raise a good potato, or a good onion, or a good anything else unless you put something into the soil to grow it. Feed your plants, and you will have some good seed and good growth.

Mr. HALE. Mr. Chairman: Brother Hoyt does not seem to think it makes any difference where seed comes from, and he illustrates his point by trees. Now, I think that is a different proposition entirely. The question of tree growth is one where the tree must remain quite a number of years in its new home before it comes to fruitage. It has to become acclimated, and become accustomed to local conditions. Our vegetables are all of one year's growth. Most of us know that where a plant is put out and it comes to a full maturity of crop quickly that that is usually where we get the most tender, must luscious, and most palatable vegetables. Now, you take trees, and they have got to get into the habit of the country that they are grown in. It is just the same with trees as it is with people. Here at the north we are a wide-awake, lively, hustling people. As you go south the people become a little more leisurely in their habits, because they no longer live under the same conditions that we do. As you go into the extreme south, to a northern man the people seem pretty easy. They are never in any hurry about anything. Now, in operating fruit farms I have learned some things along this line which shows this

same habit with trees. I have found that out by experimenting with peach trees that are grown here in Connecticut, and those grown in Georgia. The Connecticut stock has got hustle in it. Now, you take these seeds that are produced in the north and they have got the habit of wonderfully hustling. The seasons are short, and the further you go to the north to get your seed the more likely you are to have some seed with hustle in it, and you will get seed that comes to a quicker maturity.

I have been told that the Long Island farmers do not plant their own seed at all. They exchange their seed every year, and get it from the north.

Mr. HADWEN. We have some market gardeners about Worcester who are very successful. They grow their own seeds. In going through one of these gardens I found that the owner had a string tied around the pods in some cases; the pea pods and bean pods, and squashes. In fact, everything that he wanted to raise seed from. I asked the question, why they were marked with string? And he said: "Oh, they were for seed." The pea pods had to contain just so many seeds, and so with the bean pods. They must contain just so many. Some of those men are exhibitors at the Worcester horticultural meeting, and also take part in the society's exhibit at Boston. They go upon the rule that like produces like under the same conditions, and are, therefore, very particular in saving their seed.

Prof. PHELPS. This question has been discussed at considerable length, and I think that the fact that it has been indicates something of its importance. It strikes me that it is one of the most important questions that the farmers can take up. I think it is a question that we need to look into a good deal more carefully than we have. The degree of carelessness that is manifested in the selection, or non-selection I better say, of seeds is something surprising. In animals we generally acknowledge that unless we select from the best we cannot

hope to have the best. Why do we not apply the same logic to the selection of seed for the growth of our plants? It seems to me there is an opportunity here for a large amount of valuable work on the part of our practical farmers. I suppose in the selection of the seed potato we might improve the quality of our potatoes, and very likely the yield to a very great degree, if care was exercised to get only the best seed. That is, perhaps, one of the reasons why our potatoes retrograde. It is a common expression that any variety of potatoes will go back after a few years' time. Now, will it do that to the same extent that it does now if we use the same care in the selection of our seed that we do in the selection of our animals? If we select from the most vigorous plants, and the most productive plants, and the best type for quality and yield, it seems to me that it would not be so. There is certainly an opportunity for improvement in potatoes, and many of our smaller grains. At the experiment station in the Provinces at Guelph, a large amount of co-operative work is being done in just this line. There they have made a very careful selection for some years of the small grains such as wheat, oats, rye, and barley, and have men go out into the fields and mark the plants which show the best seed, and which, in all respects, are the most vigorous and productive plants. And so on the next year saving from the crop produced by these selected seed. They send this seed out to be grown upon the farms, and it has been found that seed selected in this way for a period of years has produced a vast improvement upon some of the seed which was commonly grown upon the farms of the provinces. In that way a large amount of improvement in quality and quantity of the grains grown in the provinces has been made. It seems to me that there is the same opportunity here in New England, or, in fact, all over the United States, for us to exercise greater care in the selection of our seed, and by going into the fields and selecting the plants most vigorous, and most productive of the best quality, and so keep on year after year. If we

would practice to the same extent care in the selection of the seeds of our crops and vegetation as we do in the breeding of animals I am sure we would be much more successful.

Convention adjourned until 8 P. M.

THURSDAY EVENING.

December 14th, 8 P. M.

Convention called to order at 8 P. M., Vice-President Edwin G. Seeley in the chair.

Secretary GOLD. There are a few questions in the box that we will take up before going on with the regular program. "What causes celery to grow hollow?" Any cultivator of celery here able to answer that question? Mr. Hale?

Mr. HALE. I do not know. Perhaps it is like some of the rest of us that have a tendency to grow hollow if not properly fed.

Secretary GOLD. This is a serious question asked by a man who wants some information. Prof. Gulley, what can you say about it?

Prof. GULLEY. I do not know. There does not seem to me, so far as I know, any definite reason why it should grow that way or should not. Some years it is worse than others, and it affects one place where it does not another. At Willimantic I know of men who are complaining about that trouble who usually have fine celery. At the college we did not have it so far as I know. We have been troubled there with it other years.

Mr. GOLD. I have heard it stated that a large crop of celery grown in Massachusetts was valueless on account of its being hollow. The difficulty was attributed to the variety of seed that the man sowed. Perhaps the character of the season has something to do with it. Protracted dry weather may affect it. Celery is a plant that needs a good deal of moisture for its full development. It thrives and grows best in the cold, damp

weather of October. If you can get your celery up to fair size in September, and give it a month of the cold, damp October weather, you will have some crisp, sound, and solid celery. This year it was dry, and when you worked the earth up around the plants it did not keep them moist. There was no considerable rain to moisten it. The extreme dry weather that we have had I think has a good deal to do with making the celery hollow. The white, slender variety of celery is more apt to be hollow that the old, solid varieties.

Mr. HALE. I think it does have something to do with it. The white, delicate celery plants are simply diseased plants that have been bred from diseased plants. They are not sound, and I think would be more apt to be hollow. If you go back to the good old-fashioned, solid, green celery, you will get less hollow celery, and of longer keeping qualities, but not of such fine, delicate tissue.

A MEMBER. There has been a good deal of complaint of that this year, and, as Prof. Gulley says, there is more of it some years than others. I think the hot, dry weather has a good deal to do with it.

Secretary GOLD reads: "What about Burbank's new plums, the Hale, Gold, October Purple, Wickson, etc.?" I never have heard of a plum by the name of "Gold" before, but perhaps you have heard of one by the name of "Hale." I ask Mr. Hale to tell us something about them.

Mr. HALE. The "Gold" is a cross of a Japanese with some of our native varieties. It has not done very well. It is a very weak grower, and the fruit is poor. What did fruit with me this year showed a small, hard, yellow plum, about an inch or less in diameter, and it is not near as good as some of our other varieties. The "Wickson" is justly called a Japanese plum. It has fruited sparingly in the east. It is a beautiful growing tree, and has large, open blossoms. It blossoms extremely early, which causes it to be injured by the spring frosts. It is the largest of all the Japanese plums. The fruit is of ordinary

quality, but its size and very fine appearance probably make it a valuable market plum.

The "Hale," as Mr. Gold says, is another one of Burbank's origination. It is a tremendous grower. It makes so much wood that it takes two or three years longer for it to get into bearing than it does plenty of the others that we know well. It is a medium-sized plum. The original samples were inclined to a rich, cherry red, but those that have fruited here have been a pale yellow with an occasional specimen red on the sunny side. All the rest of it has been yellow. As Prof. Bailey says it was a cherry red, but in the last two years has been yellow with occasional splashes of red on the sunny side. It is one of the most prolific of any of the Japanese plums we have.

The October Purple is a very good late plum. It is grown in California, and it has proven to be a very vigorous tree, and is a perfectly healthy, good plum in every way. It is a very good plum for the late market.

Mr. HINMAN. We have got to do some investigating and experimenting to learn about these Japanese plums. Now, I grow some of them down home, and this summer we had some yellow plums. They were fair to eat, but when we tried to cook them they were so acid as to require an enormous amount of sugar to make them palatable. Then I got some great, nice, purple plums, and took those down home. Our housekeeper tasted one of them, and she says, "I am not going to keep them. Why," she says, "there is nothing but just sour to them." They lay around the house pretty near a week, and finally my folks started in to make up some of them for ourselves, and those plums made the most delicious preserves. They had the distinct plum flavor, and proved to be just as good as a "Green Gage" to make preserves of. Now, there were two plums of an entirely different appearance and taste, and one of them was nothing but acid, and an excellent plum to preserve, and the other had no acid about it apparently, and

came out a pickle. It shows that we have got to live and learn.

Mr. HALE. I want to say just a word in relation to the Japanese "Ogon." It is a very vigorous grower, and an early bearer, but insipid, and about as poor as the ordinary California apple. There is no flavor to it. I did not know that anybody had been foolish enough to try to can them, but I do know that of the other varieties of Japanese plums the Purple, and the Chabot, and others, it is just the reverse. The ladies here know that the ordinary European plum of the standard varieties becomes acid in cooking, but the Japanese plums are just the reverse. The Japanese plums, while they are delicious for eating, are also of very great value to the country, because they are so much better for cooking purposes than any European plum. They do not lose their flavor in cooking.

Mr. HINMAN. There is one other thing about some of these varieties of plums. I do not know whether any of you, with the exception of the Secretary, ever tasted of a "Ginkgo" plum. That is the essence of everything that is undesirable in the Japanese plum. One taste of one of those is enough to last a lifetime. They are beautiful to look at, but you never want to taste of one of them but once. Japanese plums, generally, I think are liable to develop a little something in that line.

Secretary GOLD. Mr. Hinman speaks of the "Ginkgo" plum. It is the fruit of a Japanese tree; I never yet have tasted of one. I had one in my possession, and the sight of it was all that I desired. I was informed that the Chinese make use of it in their cookery. The tree is a kind of a turpentine tree, and belongs to the family of pines and cedars, and does not belong to the plum family at all. It is a very curious shaped tree; branches like an evergreen, though it is deciduous. There is a tree on the Capitol grounds in Hartford, and it is said to have borne there. Its fruit has been rarely produced

in this country. The Secretary of the Brooklyn Society of Parks told me that he was not aware that it had ever fruited in this country. This year it has fruited in Washington, and they have sent out samples of the seed. Here is a sample of the seed that I hold in my fingers. It is the first full bearing of the tree in the country that has been known to scientific men. When these trees in Washington bore fruit, it was so rare that it was gathered and distributed to the experiment stations of the country for their use. It is a very beautiful ornamental tree. It is very attractive in form. The foliage is light and airy, and turns a beautiful yellow in autumn. The fruit is about the size of a large cherry, with a stem about the length of a cherry stem, and when it is ripe it resembles a somewhat over-ripe persimmon in its character and appearance.

Mr. HOYT. In South Norwalk there is a specimen of the tree more than thirty feet high. It has been out for more than ten years, and must be six or eight inches in diameter. I never heard that it had borne fruit.

The PRESIDENT. I think we will take up our program now. After we have had some music we will go on with the regular lecture for the evening.

[Music.]

The PRESIDENT. That which comes next on the program is a lecture on the " English Language and Literature." That is a curious subject for an agricultural meeting, is it not? Just think of it. And when you think of it, it does not look so queer after all. A farmer wants to know how to talk. If a man meets another he don't want to stop and take his pencil out to write out something. He wants to know how to talk, and how to say what he means. The man who stood before you this morning talking, Colonel Wood, is a farmer. His father was a farmer, and his grandfather was one, and he has always been identified with the tilling of the soil. He lives over here

near western Connecticut, — not in Connecticut exactly, but in what the Governor tried to make us believe ought to have been Connecticut. Why, do you know, when that man is talking, he can almost make you laugh or cry, or think just as he thinks. How does he do it? Why, it's his language. And, not only what he says, but the language of his eye, and of his hand, and the looks of the man himself. Why, he held his audience spellbound for more than an hour, like an old-fashioned orator. Why should not any farmer learn to talk just as well? Why shouldn't he do it? Who under the light of the sun needs education more or better than the farmer? He has to do with everything. The food that he eats, the cattle that he raises, the plants he is cultivating. The farmer and his wife should be the best educated man and woman in the world, and not only the farmer and his wife, but the farmer's sons and his daughters. It is something which we need to emphasize more and more; that the farmer in the calling which he represents, if he would take the place in the community which he ought, and hold it as he ought, must be a well-educated man. I have the pleasure of introducing Prof. R. W. Stimson of the Connecticut Agricultural College.

THE ENGLISH LANGUAGE AND LITERATURE.

Prof. R. W. Stimson.

Ladies and Gentlemen: — I am not an imperialistic expansionist, but I believe that there is a tree whose leaves are for the healing of the nations. That tree is English Speech. And this conviction lends tremendous significance, Mr. President, to my invitation to address this convention upon the subject assigned me.

To-night, therefore, I want to address you as English-speaking people, but especially as English-speaking Americans, New Englanders, and citizens of Connecticut. And I am very glad of this opportunity to direct your attention to the

instruction and inspiration to be had from the study of the English people, their language and their literature.

In your old school geographies you must remember having seen, across the top of one or more of their pages, pictures of the various types of people from different parts of the world — from Europe, Asia, and Africa, from North and South America, from Australia, and from the islands of the sea. And in recent years it must have seemed to you as if people from every tribe the sun ever looks down upon had arrived upon our shores, and were knocking upon our very gates for food and work and the right to vote.

As Americans, I think we are sometimes distrustful of our destiny because of the composite character of our people. The passing of the Puritan is lamented. The inroads of the continental Sunday upon our wonted New England Sabbath are decried. "Young America" has become the synonym of all that is impudent, irreverent, upstart. Whatever is alien to our traditional code and character fills us with misgiving for the future of our politics and of our culture. And the influx of so-called foreigners is made the scapegoat of whatever we regret, rebuke, or repudiate.

We must be strong to meet the conditions that confront us, and distrust is deadly. It is a rust that disfigures, weakens, and ultimately breaks the finest steel. In union there is strength. What, therefore, we want to do is to strengthen the noblest ties that tend to bind us, to close the fissures which already begin to yawn, to be infused by a common spirit of enthusiasm and devotion which shall make us a more and more righteous, beneficent, and joyous people. And what I would like to do first to-night is to add to your confidence in our destiny, by bringing to your attention the actual origin and development of the English-speaking people.

It is easy to forget that our forefathers had not always lived in old England, and that when they came to Britain they came from the continent of Europe, wild land-pirates and sea-wolves, foreigners, adventurers, and invaders, Jutes, Angles, Saxons, Danes, and Norman French.

Or, if we remember these things, we are wont to think of ourselves as Teutonic in our origin. And when we look further back, we point with great sense of dignity to the Aryans of Asia. "In our school days," says Professor Ripley, in a

"profound and scholarly work"* just published, "In our school days most of us were brought up to regard Asia as the mother of European peoples. We were told that an ideal race of men swarmed forth from the Himalayan highlands, disseminating culture right and left through the barbarous west."†

Many earlier conclusions have been entirely broken down by more recent investigations, and our ill-chosen or mistaken ideas need abandonment or correction.

In a monograph just published,‡ M. Georges Vacher de Lapouge, a French scholar, says, "Probably no tribe in the world can be found entirely homogeneous, and this appears to be equally true of tribes in the past."

In earlier times, when a stronger tribe of one race conquered a weaker tribe of another race, the lives of the younger women were spared and they were made the slaves of the victors. The blood of the two races became mixed in the children of these women. And the alien strains of blood thus introduced were spread through the veins of many later and different tribes, both by conquest and by friendly intermarriage.

In the light of the most complete evidence now in hand, it is at last clear, M. Lapouge holds, that the Aryan peoples were not descended from a single homogeneous family or tribe which was resident in the Asiatic table-lands of eastern Persia, and into which no foreigner or doubtful person had ever found his way, but sprang from various earlier nomad peoples who occupied a large western area; and he holds that "if we trace on a map the known lines of the migrations of the Aryan peoples, the arrows point as if they had all been shot from a bow in central Europe." The migrations toward India and Iran are southeast, and those of the Armenians and the Phrygians are in much the same direction; the Greeks and Latins moved southward; the Gauls and Germans southwest; the Scandinavians northward, and the Slavs northeast.

Professor Ripley is no less clear in maintaining the various origins of the Aryan peoples; for he finds their ancestors to

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* See *Boston Transcript*.

† William Z. Ripley, "*The Races of Europe*," N. Y., D. Appleton & Co., 1899.

‡ *American Journal of Sociology*, V. 329 ff., Nov., 1899.

have varied even so extremely as from the African to the Asiatic, from the negro to the white.

Therefore, in trying to increase your trustfulness in the future of our people, the first thing I would impress upon you is their undoubtedly mixed and various racial origin and development. The second thing is the even more mixed and various origin and development of their language and literature.

The various Aryan peoples had in their language common elements. For example, under the disguises of altered spelling, the word *wagon* is found in all the Aryan tongues. So also in all the Aryan languages, among the names of blood relatives, the words *father*, *mother*, *sister*, and *daughter* are the same.*

Despite such common elements, however, there was great diversity of speech. Of the first invaders of Britain, called by the collective term English, the Angles, Saxons, and Jutes each had a distinct dialect, and each for some time occupied in Britain separate territory. Out of that diversity of dialects sprang the earliest English speech, as out of those tribes sprang the earliest English people.

When, afterwards, the Danes invaded Britain, they were absorbed and the language remained English. When later the Normans invaded England, they, too, were absorbed, and the French elements they brought with them were taken into our language and literature. Since that time our language and literature have been subject to all manner of foreign influence, by means of which or in opposition to which they have so far perfected their development and asserted their preeminence.

Our fathers have been great travelers and readers. The subjects of their interest have not been confined to English soil and folk, but have included the farthest lands and strangest peoples. Home they have come from all peoples and places, from all languages and literatures, laden with treasure. From pillage and oppression they have risen strengthened and enriched, especially in their speech.

Not only by the Aryan peoples, such as the Germans, French, and Italians, and the more ancient Greeks and Romans, but also by peoples not Aryan, that is, by the Celts,

* Fisher: *Brief History of Nations*, 4.

by the original inhabitants of Britain, and by the Semites, their speech and thought have been influenced. Most conspicuously of all, perhaps, they have been influenced by the Semitic people through the Old and New Testaments, parts of which very early were translated and the whole of which has existed in form familiar to us since the appearance of the King James Bible.

If the book of English speech is a book of a thousand leaves, not one hundred leaves but more than one have been torn from foreign tongues and from foreign thought.

Early English speech differs so radically from modern in the appearance of its alphabet, in the form of its words and idioms, and in its pronunciation, that it is almost as difficult to read as a foreign tongue. To read the Bible in Anglo-Saxon requires considerable study and the use of a special grammar and dictionary. To read intelligibly the English of the so-called middle period, a glossary is necessary. And in our time, of the hundreds of thousands of words to be found in our largest dictionaries and encyclopædias only an infinitesimal proportion are commonly understood by all the English-speaking people.

Yet, notwithstanding this most mixed and various origin, and the composite character of its present total content, English speech has maintained the continuity of its development in language and literature from its earliest beginnings to the present time, and throughout has presented to the world characteristics fundamentally and distinctively its own.

One picture, therefore, may present to your view the rise both of the English-speaking people and of their language and literature. It is the picture of a stream, which, starting with the meeting and mingling rivulets from a half-dozen fountain-heads, has been fed along its course by a thousand springs and colored by a thousands banks and bottoms, until it has grown into a mighty flood — a veritable river of life, which, if it has not proceeded from the throne of God, seems to be proceeding to it. And I can imagine nothing better fitted to inspire us with intelligent and enthusiastic confidence in our future than a rapid backward glance along this wonderful river.

" It has been estimated," says Professor Brander Matthews, " that in the time of Chaucer," in the fourteenth century, " less than three millions of men and women spoke English, and in

the time of Shakespeare," in the sixteenth century, " less than seven millions; and all these lived in the British Isles. But after a while the British Isles became too small for those who spoke English. Men and women went east and west out of England and settled in the four corners of the earth. They grew in numbers rapidly.

" Another estimate shows that at the beginning of the nineteenth century probably about twenty million men and women spoke English, while about thirty-one millions spoke French, and about thirty millions spoke German. Now, at the end of the nineteenth century, it is believed that about fifty millions speak French, and about seventy millions speak German, while more than a hundred and twenty-five millions speak English. Our language is spreading far more rapidly than any other; and the prophecy has been made that at the end of the twentieth century the number of those who use the English language will be fully a thousand millions." *

To-day the position of the English-speaking people is unsurpassed for its dignity and for its influence. And our own position as Americans, with our population of more than seventy millions, in a republic free from feudal chains, " without caste and class distinctions, and with public schools open to rich and poor alike," — our position is in the very vanguard of enlightenment and progress.

Other people are looking to us and are depending upon us. The great English scholar, Mr. James Bryce, " who seems to understand us better than we do ourselves, and who has written the best book on the American commonwealth," visited our country a few years ago. He seemed to become more full of the noble destiny before us, but also he seemed to feel more keenly the dangers which threaten us. And I am told that, just as he was stepping on board ship to go home, he turned, and, with tears in his kind, searching eyes, said to the little company of friends who had come to see him off, " Don't make a failure of it in America; don't make a failure of it! For you don't know how much we Liberals in England are depending upon you. If you make a failure of it here, it will set us back a hundred years."

We must not make a failure of it. And if we would succeed, we must understand and justly appreciate our past; we must

* *Introduction to American Literature*, 11.

understand and justly appreciate our traditional laws, institutions, and ideals; and we must understand and justly appreciate our neighbors and ourselves. And this understanding and appreciation can best be had through the study of our language and literature.

English prose may fairly be said to begin with Baeda. Baeda was born in 673 and was a Northumbrian. He spent his life at Jarrow in a monastery. And he says of himself, "While attentive to the rule of mine order, and the service of the church, my constant pleasure lay in learning, or teaching, or writing."

"His learning," says Mr. Stopford Brooke, "was as various as it was great. All that the world then knew of theology, science, music, rhetoric, medicine, arithmetic, astronomy, and physics was brought together by him; his Ecclesiastical History is our best authority for early England; accuracy and delightfulness are at one in it. . . . His books were written in Latin, and with these we have nothing to do, but he strove to make English prose a literary language," and "almost his last words were in English verse." It is to his writing that "English prose looks back as its sacred source, as it is in the greatness and variety of Baeda's Latin work that English scholarship strikes its keynote."

"When Baeda died, Northumbria was the center of European literature." *

Since Baeda, English life has broadened and deepened and become more complex. Scholars are turning the most careful scrutiny upon all things past, present, and future, and are clamoring for our attention that they may place before us the results they have found.

One is a student of governments, and would depict for us the excellences and defects of the absolutism of Russia, of the constitutional monarchy of England, or of the constitutional democracy of our own country.

Others are interested in the special contributions to civilization made by different nations, and would win our lasting and enthusiastic gratitude for these.

The Romans were lovers of law, and the Justinian code is famous as the foundation of the soundest legal holdings. Greece was eminently artistic, and her enduring fame is found

* Brooke: *English Literature*, 25–26.

in her surpassing art remains. The Hebrews were a peculiar people, their central interest was religion; and the religious fortune of the world for two thousand years has more and more been shaped by the transcendent spiritual insight and outlook of Jesus of Nazareth.

Still others would interest us in the primal elements of earth, air, fire, and water; in the rocks and mines; in the clouds and rainbow; in hill and dale, and in fern and flower; in all the creatures of land and sea; in the regions of fiery heat, and in those of icy cold; in the twinkling lanterns of the starry night, and in the glowing splendor of the king of noon; in childhood, youth, and age; in the body's hurt and health; in the life that is here, and in the life beyond the bourn.

Now the English language and literature is the record of the thoughts, the emotions, and the deeds of the English-speaking people, beginning with the earliest poets and prose writers and continuing till the present moment. Consequently the field of our language and literature is as vast and as varied as are the combined interests of the English-speaking people.

As our language and literature is the record of our life, so it is to serve the ends of our life. We all are workers; and we all are people of leisure, be our idle hours few or many. Our interests, therefore, are of two distinct kinds: those which have to do with our work — our bread-and-butter interests, and those which occupy our leisure time — our off-duty interests. We have two paramount duties: work and recreation. Our ends of life must be two: skill in our special calling, and enjoyment of the best in life at large. The great field of language and literature may be entered and delved in for two great purposes: for power and for pleasure. And these two distinct interests, duties, ends, or purposes, must balance each other, if we would have skill without narrowness, and if we would have breadth without sacrifices of power.

Our special callings are for the most part so attractive, and our devotion, not only to earning a dollar more, but to earning our dollars better, is so absorbing that we are in danger of drawing the string of our calling too tight, the bow too often is just on the point of breaking. Consequently I assume to-night that we shall approach our language and literature quite as often as we ought to increase our efficiency in our special callings.

And hence I wish to direct your attention, in the time that remains, to that in our language and literature which tends not to divide but to unite us all, and which, in hours of recreation from our special toil, tends to upbuild us as English-speaking people in spiritual worth and in moral efficiency.

Some of you, I am sure, have already given attention to this matter; it is to those of you who have not, therefore, that I want now to speak. I can hardly more than introduce you to this infinite source of instruction and delight, but what we begin to-night you may pursue in your future leisure hours with increasing pleasure and profit.

I wish first to interest you in the study of words.

"Sound and sense are the two factors which make up speech." * And writing makes speech visible, durable, and portable to the most distant land and to the most remote generation.

"It does not matter," says Professor Max Müller, "what language we take or what word we choose; every one of them will carry us back to the time when there were no statues, no gems, no coins, no cylinders, no pyramids, not even lacustrian dwellings, stone hammers, or flintheads. For all these are the workmanship of intelligent beings, and no being can be intelligent without language."

"Each word has its biography beginning with its birth, or at least with its baptism. We may speak of its childhood, its youth, its manhood; and old age, nay even of its death, and of its heirs and successors."

"Every word, therefore, has a story to tell us, if only we can break the spell and make it speak out once more." †

Every word which is capable of analysis has its original idea deeply imbedded in it in what is called its root. "A river is a runner, and pre-supposes a root meaning to run; a tree is what can be torn or peeled or hollowed out or shaped into shafts, and pre-supposes a root meaning to tear." ‡

Professor Ramsey has an interesting passage on the root. "We may get an idea of a root sufficient for our present purpose," he says, "by taking such a series as com-*pel*, dis-*pel*, ex-*pel*, im-*pel*, pro-*pel*, re-*pel*, and calling *pel* a root with the

* Sayce: *Introduction to the Science of Language*, 141.
† Max Müller: *Biographies of Words and the Home of the Aryans.*
‡ Max Müller: *Ibid.*

sense of *drive*. The other syllables in this instance are termed *prefixes*; if they followed the root they would be called *suffixes*. The root itself may undergo changes, as in com-*pul*-sory, im-*pul*-sive. As the root may run through a large family of languages, it can sometimes be traced in several thousand combinations. The same prefixes and suffixes may be attached to many different roots; thus *in*-tend, *in*-spire, *in*-flection." *

In time derivatives from other roots are added, and the new words thus presented carry an added or a changed meaning.

What, for instance, is the root meaning of the word father? I have seen no more plausible interpretation than that of Professor Max Müller that "it meant feeder, protector, ruler." *Pater*, Sk. *pitar*, consists of a root element *pa*, and a derivative element *tar*. The root *pa* means *to feed*, in our *pa*-bulum, food; in Sk. *go-par*, cow-herd, it means *to protect;* in Sk. *pa-ti*, lord, it means *strong*, *ruler*, *king*. If this account be accepted, it is plain how much of the original meaning of provider, protector, and preceptor has been retained in our own understanding of the best father.

"The original meaning" of a root, however, "is often lost sight of and the derived alone remains. Thus *spirit* once meant only breath — *in-spire* and *ex-pire*, to breathe in and breathe out; *comprehend* was to grasp and hold together, and *disgust* was a bad taste in the mouth." † The secondary or figurative meanings of *spirit*, *comprehend*, and *disgust* are the ones familiar to us.

Words not only change in meaning in the course of time, but words that happen to be used often together come to be combined and pronounced as one. This is a gradual process in which Professor Ramsey has shown us that we may easily discern three steps. "In *brick house* we have two distinct words, but brick has become an adjective descriptive of house; in *work-house* two words are treated as one, but to show that they are not perfectly consolidated, a hyphen (-) is placed between them. The first part is uttered forcibly, the second lightly. The greater stress is called accent, and the two parts have but one — that is, they are accented as one word. When we come to *householder* we are no longer notified that the parts were ever separate. Under which of the three forms we

* Ramsey: *English Language and English Grammar*, 55.
† Ramsey, *Ibid.*, 55.

shall find any combination depends upon length and frequency of use. *Turnspit* is written without, and *turn-table* with, a hyphen, because the English-speaking people have been much longer used to roasting meat on a spit than to turning cars on a table." *

"But laziness will not rest here," says Professor Ramsey. Familiar expressions must be shortened. And as the masterpiece of all he cites the one most common, our *yes'm*. For he says "the final *m* of the housemaid's hourly *yes'm* is all that remains of the once dignified *mea domina*." †

Many, perhaps most, of our words were formed or adopted quite arbitrarily to express ideas. But there is one interesting class of words, called onomatopœic, which are formed by imitating natural sounds. It is not necessary that the imitation be exact; indeed, as Professor Sayce says, "that it can never be; all that is wanted is that the imitation should be recognizable by those addressed." ‡

Professor Welsh has collected some interesting examples of such word formation. "Thus the cry of the cat to children of different nationalities is *e-yow*; the watch is *tick-tick*. . . . The Australian, imitating the noise it makes, calls the frog *kong-kung*. . . . Several tribes on the coast of New Guinea give names to their children in imitation of the first sound the child utters. Familiar instances of inventing names by imitating natural sounds are *whip-poor-will, pee-wee, bob-white, buzz, whiz, hiss, snap, snarl, bang, roar*. There is the story of the Englishman who, wanting to know the nature of the meat on his plate at a Chinese entertainment, turned to the native servant behind him, and, pointing to the dish, inquired, '*Quack, quack?*' The Chinaman replied, '*Bow-wow.*' Thus the two were mutually intelligible, though they understood not a word of each other's language." §

More profitable than all this, however, and no less interesting, is the light thrown on the history of our people by the study of words. The struggle of words into use often has been coincident with the struggle of a people into a commanding position. We see this, for example, in the displacement for a time of Anglo-Saxon by Norman-French names; because the

* Ramsey, *Ibid.*, 56.
† *Ibid.*, 57.
‡ Sayce, 108.
§ Welsh: *Development of English Literature and Language*, 41.

Anglo-Saxon words were considered by the Norman-French as badges of inferiority and dependence. "*Ox, calf, sheep, pig, deer* are Anglo-Saxon names; while *beef, veal, mutton, pork,* and *venison* were Norman-French; because it was the business of the former part of the population to *tend* these animals while living, and of the latter to *eat* them when prepared for the feast." * And we have a permanent memorial of this struggle in the latter five very common words which were added to our vocabulary at that time.

"Supposing all other records to have perished, we could still trace the reciprocal relations of the Saxon and Norman occupants of England in their contributions to the language which they have jointly bequeathed us. Thus we should conclude that the Norman was the ruling race from the noticeable fact that nearly all the words of state descend to us from them, — *sovereign, throne, crown, scepter, realm, royalty, prince, chancellor, treasurer.* Norman aristocracy transmits us *duke, baron, peer, esquire, count, palace, castle, hall, mansion.* Common articles of dress are Saxon, — *shirt, shoes, hat, breeches, cloak;* but other articles subject to changes of fashion are of Norman origin, — *gown, coat, boots, mantle, cap, bonnet,* etc. *Room* and *kitchen* are Saxon; *chambers, parlors, galleries, pantries,* and *laundries* are Norman. The Saxon's *stool, bench, bed,* and *board* — often probably it was no more — are less luxurious than the *table, chair,* and *couch* of his Norman lord. The *boor* whose sturdy arms turned the soil, opened wide his eyes at the Norman *carpet* and *curtain.* While luxury, chivalry, adornment, are Norman, the instruments used in cultivating the earth, as well as its main products, are Saxon, — *plow, share, rake, scythe, harrow, sickle, spade, wheat, rye, oats, grass, hay, flax.*

"Thus are words, when we remove the veil which custom and familiarity have thrown over them, seen to be illustrative of national life. As the earth has its strata and deposits from which the geologist is able to arrive at a knowledge of the successive physical changes through which a region has passed, so," says Professor Welsh, in agreement with Professor Sayce and other careful students of the history of words, "language has its alluvium and drift from which the linguist may disinter in fossil form the social condition, imaginations, and feelings

* Welsh, 11.

of a period — a period far more remote than any here suggested." *

Most immediately rewarding of all, and still quite as delightful, is the study of words to determine their fitness for present use.

" Every successive inquirer into human nature," says Professor Laurie, " has descanted on the error, misunderstanding, and consequent misery into which an abuse of words is constantly betraying mankind." † And Mr. Richard Grant White similarly argues that " The right use of words is not a matter to be left to pedants and pedagogues. It belongs to the daily life of every man. The misuse of words confuses ideas and impairs the value of language as a medium of communication. Hence loss of time, money, and sore trial of patience. It is significant that we call a quarrel a misunderstanding. How many lawsuits have ruined both plaintiff and defendant, how many business connections have been severed, how many friendships broken, because two men gave to one word different meanings? The power of language to convey one man's thoughts and purposes to another is in direct proportion to a common consent as to the meaning of words." ‡

Most, if not all, of our language comes to us through imitation.

Mr. Richard Grant White, in the preface to his *Words and Their Uses*, gives an amusing, though, he admits, trifling, instance of " mere thoughtless imitation of slovenly exemplars."

" Professor Whitney mentions, as one of his many illustrations of the historical character of word-making, that we put on a ' pair of *rubbers* ' because, when caoutchouc was first brought to us we could find no better use for it than the rubbing out of pencil-marks. But overshoes of this material," says Mr. White, " are not universally called ' *rubbers*.' In Philadelphia, with a reference to the nature of the substance of which they are made, they are called ' gums.' A Philadelphia gentleman and his wife going to make a visit at a house in New York, where they were very much at home, he entered the parlor alone; and to the question, ' Why, where is Emily? ' an-

* Welsh, 57; See also Sayce, 140, and Max Müeller: *Lectures on the Science of Language*, and *Biographies of Words, and the Home of the Aryans.*

† *Languages and Linguistic Study*, 187.

‡ *Words and their Uses*, 80.

swered, 'Oh, Emily is outside, cleaning her gums upon the mat;' whereupon there was a momentary look of astonishment and then a peal of laughter." And in commenting upon this, Mr. White urges that there is "no need whatever of the use of either of the poor words *rubbers* or *gums* in this sense. The proper word is simply *overshoes*, which expresses all that there is occasion to tell, except to a manufacturer or a salesman. There is neither necessity nor propriety in our going into the question of the fabric of what we wear for the protection of our feet, and of saying that a lady is either rubbing her rubbers or cleaning her gums on the mat; no more than there is in our saying that a gentleman is brushing his wool (meaning his coat), or a lady drying her eyes with her linen (meaning her handerchief)." *

Not long ago several students at Harvard College were asked to define a number of words, and among them the word *trolley*. I speak of this because if I were to follow my exemplars in Connecticut, I should always speak of boarding the trolley when I meant boarding the *electric car*. Only one of the students questioned gave the true definition of the trolley as the little wheel which runs along the bottom of the wire above the car and takes off the electricity needed by the electric motor. Many respectable elderly men and women ride on the electric cars daily; the most reckless aerial gymnast would not venture to ride on the trolley.

Our speech is too much divided already into dialects, or forms of expression understood only in special localities. Without their peculiar forms of expression the people of Mr. G. W. Cable and of Mr. Bret Harte would no doubt lose something of their picturesqueness. So would *Chimmie Fadden* and *Mr. Dooley;* so also would *Hosea Biglow* and *David Harum.* But good English is not to be sought best in the language of these people, any more than in Great Britain in the Welsh spoken in Wales, in the Manx spoken in the Isle of Man, in the Scotch Gaelic spoken in the Highlands of Scotland, or in the Irish Gaelic spoken in Ireland.†

We are obliged to use special and technical words in our particular callings, but outside of these we ought to use only such words as must carry their meaning unmistakably and by

* *Ibid.*, 5–6.

† See Latham: *An Introduction to the Study of the English Language.* See also O. F. Emerson: *The History of the English Language*, 99 ff.

common consent to the English-speaking people at large. We must begin somewhere. Suppose we begin our good English speech by the use of *overshoes* and *electric cars*. And let us not rest content until we have banished from our tongues all slang and provincialisms and acquired a respectable stock of beautiful and widely intelligible words.

For two great and sufficient reasons, therefore, it is proper to interest you in the study of words: it will afford you pleasure, and it will yield you profit. But there is a third motive, which ought to prompt every man irresistibly to the study of English words, namely, desire worthily to inherit the splendid treasure of life which has been achieved by the English-speaking people. For it may almost be said that there is absolutely no process by which this noblest heritage can be transmitted save by the mastery of words.

Language by most of us is simply learned. A word is the sign of an idea, and when it is really mastered a word becomes both the sign and the idea. "There is obviously mental training and shaping, as well as mental equipment, in the process of learning to speak," says Professor Whitney. "The mental action of the individual is schooled into certain habits, consonant with those of his community; he acquires the current classifications and abstractions and ways of looking at things. To take an example: the quality of color is so conspicuous, and our apprehension of it so urged by the infinity of its manifested differences which are ever before our eyes, that the conception of color is only quickened and rendered more distinct by acquisition of the words which denote it. But in the classification of the shades of hue the phraseology of the language acquired bears a determining part; they fall into order under and about the leading names, as *white*, *black*, *red*, *blue*, *green;* and each hue is tested in the mind by aid of these, and referred to the one or the other class. And different languages make different classifications; some of them so unlike ours, so much less elaborate and complete, that their acquisition gives the eye and mind a very inferior training in distinguishing colors. This is still more strikingly the case as regards number. There are dialects which are in a state of infantile bewilderment before the problem of enumeration; they have words for 'one,' 'two,' and 'three'; but all beyond is an undivided 'many.' None of us, it is tolerably certain, would

ever have gone farther than that by his own absolutely unassisted efforts, but by words — and only by words." *

". . . All through the world of matter and of mind our predecessors, with such wisdom as they had at command, have gone observing, deducing, and classifying; and we inherit in and through language the results of their wisdom." †

In these later days we are hearing less about synonyms. Each word has a meaning, in some shade or degree or kind, peculiar to itself. "A word," says Mr. Richard Grant White, "can have but one real meaning." ‡ The most modest estimate of the number of the words in our rich and long-cultivated English language would be about 100,000. And to appreciate how far we are from fully or worthily appropriating this wonderful heritage we have but to think a moment.

"We say . . . of a child who has reached a certain grade that he has 'learned to speak'; but," says Professor Whitney, "we mean by this only that he has acquired a limited number of signs, sufficient for the ordinary purposes of the childish life, together with the power, by much practice, of wielding them with adroitness and general correctness. There are, probably, only a few hundred such signs, all told; and outside their circle, the English is as much an unknown language to the child as is German, or Chinese, or Choctaw." §

"Listen to the average schoolboy," says Professor Palmer. "He has a dozen or two nouns, half a dozen verbs, three or four adjectives, and enough conjunctions and prepositions to stick the conglomerate together. This ordinary speech deserves the description which Hobbes gave to his State of Nature, that 'it is solitary, poor, nasty, brutish, and short.' The fact is, we fall into the way of thinking that the wealthy words are for others, and that they do not belong to us. We are like those who have received a vast inheritance, but who persist in the inconvenience of hard beds, scanty food, rude clothing, who never travel, and who limit their purchases to the bleak necessities of life. Ask such people why they endure niggardly living while wealth in plenty is lying in the bank,

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* Whitney: *Life and Growth of Language*, 20.
† *Ibid.*, 21.
‡ *Words and their Uses*, 389.
§ Whitney: *Life and Growth of Language*, 25.

and they can only answer that they have never learned how to spend. But this is worth learning." *

Thirty thousand words is a very large estimate for the number ever used, in writing or speaking, by a well educated man. Shakespeare used fifteen thousand, Milton eight thousand. Three to five thousand, it has been carefully estimated, cover the ordinary needs of even cultivated intercourse.† One shrinks from thinking of how few words are ever used from day to day by one's self or by one's neighbors. But our poverty is not more appalling than pitiable because so needless.

Professor Palmer's words are not too strong, and I wish that his entire passage might be remembered. "We are simply lazy," he says; "too lazy to make ourselves comfortable. We let our vocabularies be limited, and get along rawly without the refinements of human intercourse, without refinements in our own thoughts; for thoughts are almost as dependent on words as words on thoughts. For example, all exasperations we lump together as 'aggravating,' not considering whether they may not rather be displeasing, annoying, offensive, disgusting, irritating, or even maddening; and without observing, too, that in our reckless usage we have burned up a word which might be convenient when we should need to mark some shading of the word 'increase.' Like the bad cook, we seize the frying-pan whenever we need to fry, broil, roast, or stew, and then we wonder why all our dishes taste alike while in the next house the food is appetizing. It is all unnecessary. Enlarge the vocabulary. Let anyone who wants to see himself grow, resolve to adopt two new words each week. It will not be long before the endless and enchanting variety of the world will begin to reflect itself in his speech, and in his mind as well. I know," he says, "that when we use a word for the first time we are startled, as if a firecracker went off in our neighborhood. We look about hastily to see if anyone has noticed. But, finding that no one has, we may be emboldened. A word used three times slips off the tongue with entire naturalness. Then it is ours forever, and with it some phase of life which had been lacking hitherto. For each word presents its own point of view, discloses a special aspect of things, reports some little importance not otherwise conveyed, and so

* G. H. Palmer: *Self-Cultivation in English*, 17-18.

† See Whitney: *Life and Growth of Language*, 26; and G. H. Palmer: *Self-Cultivation in English*, 18.

contributes its small emancipation to our tied-up minds and tongues." *

In my work as a teacher, I have found it not one-quarter so hard to get my students to read as to get them to read intelligently. It is vastly easier to find people who read, from book to book, many books, than it is to find people who read with proper understanding and deep appreciation, from page to page and from chapter to chapter, each book they choose. Hence the great emphasis I have laid upon the mastery of even the smallest units of our speech, namely, words.

You will notice that to-night I have given more time and space to the study of words than I now am about to give to a further effort to interest you in the study of our best literature. This is because, as a matter of fact, we cannot move at all in the right study of language without instantly finding ourselves in the study of literature. We must turn to our dictionaries for definitions or words; but it is to the great record of our life — to our literature, that we must turn for examples of the usage of words and for the broad purport of their meaning. Consequently he who studies our words must, perforce, become a student of our literature; and he must, thereby, become more and more cognizant and appreciative of our origins, of our development, and of our contemporaneous significance, as English-speaking people.

If discipline and enrichment of mind are to be had from the study of our language, untold discipline and enrichment not only of mind but of character are to be found in the study of our literature.

The Germans have a proverb: A man is what he eats. " Neither originality nor even genius," says M. Brunetière, the great French critic, " consists of being without ancestors."† From the point of view of mind and character, a man is what he thinks, what he feels, and what he does. And, other things being equal, he must be the best man who keeps the best company.

But how will you keep the best company unless you resort to books? The Chinese have a famous saying that " A single conversation across the table with a wise man is better than

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* *Self-Cultivation in English*, 18-19.

† M. Ferdinand Brunetière: *Manual of the History of French Literature*, Eng. trans., viii.

ten years' study of books." * But the difficulty is to find that wonderful wise man; and, then, having found him, the difficulty is, as Mr. Ruskin has so memorably pointed out in his *Sesame and Lilies*, to get a chance to talk with him across the table.

Away from books, "Nearly all our associations are determined by chance or necessity, and restricted within a narrow circle. We cannot know whom we would; and those whom we know, we cannot have at our side when we most need them." †

No matter how bare or how desolate our surroundings may be, however, and no matter how distant our noblest neighbor, if only we will turn to books we shall find "a society continually open to us, of people who will talk to us as long as we like, whatever our rank or occupation — talk to us in the best words they can choose, and with thanks if we listen to them." ‡

If we would be noble we must for at least some few heavenly moments of life associate with the noble; and, if we would find the noblest, we shall often need to turn to books. And if we would choose the best books, I do not know to whom we could so profitably turn for general advice as to Mr. Ruskin.

Mr. Ruskin divides good books into two classes: "the books of the hour and the books of all time." And then he tells us how to choose them, and how to choose between them.

"The good book of the hour," he says, "is simply the useful or pleasant talk of some person whom you cannot otherwise converse with, printed for you. Very useful often, telling you what you need to know; very pleasant often, as a sensible friend's present talk would be. These bright accounts of travels; good-humored and witty discussions of question; lively or pathetic story-telling in the form of novel; firm fact-telling by the real agents concerned in the events of passing history; — all these books of the hour, multiplying among us as education becomes more general, are a peculiar characteristic and possession of the present age; we ought to be entirely thankful for them, and entirely ashamed of ourselves if we make no good use of them. But we make the worst possible use, if we allow them to usurp the place of true books: for, strictly speak-

* Quoted by Longfellow: *Hyperion*, ch. 7.
† *Sesame and Lilies*, 31.
‡ *Ibid.*, 31.

ing, they are not books at all, but merely letters or newspapers in good print. Our friend's letter may be delightful, or necessary, to-day: whether worth keeping or not, is to be considered. The newspaper may be entirely proper at breakfast time, but assuredly it is not reading for all day. So, though bound up in a volume, the long letter which gives you so pleasant an account of the inns, and roads, and weather last year at such a place, or which tells you that amusing story, or gives you the real circumstances of such and such events, however valuable for occasional reference, may not be, in the real sense of the word, a 'book' at all, nor, in the real sense, to be 'read.' A book is essentially not a talked thing, but a written thing; and written, not with a view of mere communication, but of permanence. The book of talk is printed only because its author cannot speak to thousands of people at once; if he could he would — the volume is mere *multiplication* of his voice. You cannot talk to your friend in India; if you could, you would; you write, instead: that is mere *conveyance* of voice. But a book is written, not to multiply the voice merely, not to carry it merely, but to preserve it. The author has something to say which he perceives to be true and useful, or helpfully beautiful. So far as he knows, no one has yet said it; so far as he knows, no one else can say it. He is bound to say it, clearly and melodiously if he may; clearly at all events. In the sum of his life he finds this to be the thing, or group of things, manifest to him; — this the piece of true knowledge, or sight, which his share of sunshine and earth has permitted him to seize. He would fain set it down forever; engrave it on rock, if he could; saying, 'This is the best of me; for the rest, I ate, and drank, and slept, and loved, and hated, like another; my life was as the vapor, and is not; but this I saw and knew: this, if anything of mine, is worth your memory.' That is his 'writing'; it is, in his small human way, and with whatever degree of true inspiration is in him, his inscription, or scripture. That is a 'Book.'" *

It is the quality of permanent importance which has given rise to the term classic, or classical, as applied to the masterpieces of fact or of fiction; and which has made our understanding and appreciation of them such an indispensable means of the fullest manhood.

* *Ibid.*, 32–34.

It is this which sometimes makes fiction truer than fact; and which, consequently, places the writing of the best novelists so high.

"Place side by side," says Professor Richard G. Moulton, in his introduction to a little guide-book for a four years course of novel reading, "a biography of John Smith and a biographic novel like *Daniel Deronda* or *John Inglesant:* the novel will be 'truer' than the biography, in the sense that it will contain more of 'truth.' However great and worthy John Smith may be, his life must include a large proportion of what is accidental, special to the individual. The biography must insert this because its fidelity is to the facts. But a George Eliot has no motive for introducing anything that is not of general and universal significance. The biography will be the ore as it comes from the mine, gold and alloy mixed; the novel will be pure gold. Even this is an understatement of the case. The hero of a novel is not an individual at all, but the type of a whole class; not only will there be nothing accidental in the portrait, but in this one figure will be concentrated the essence of a hundred Daniel Derondas. The biography is the single specimen, and its gold is diluted with three times its weight of alloy; the truer novel is gold only, and gold from a hundred mines." *

And, similarly, to take another example, it is this quality of permanent importance which places the writing of the best poets so high.

"If," says Mr. Matthew Arnold, in his introduction to Mr. Ward's four-volume edition, *The English Poets*, "he is a real classic, if his works belong to the class of the very best (for this is the true and right meaning of the word *classic, classical*), then the great thing for us is to feel and enjoy his work as deeply as ever we can, and to appreciate the wide difference between it and all the work which has not the same high character. This is what is salutary, this is what is formative; this is the great benefit to be got from the study of poetry."†

And, in connection with these words, you may like to remember also his closing words: " . . . We are often told that an era is opening in which we are to see multitudes of a common sort of readers, and masses of a common sort of

* Richard G. Moulton: *Four Years of Novel Reading*, 5-6.
† xxii.

literature; that such readers do not want and could not relish anything better than such literature, and that to provide it is becoming a vast and profitable industry. Even if good literature entirely lost currency with the world, it would still be abundantly worth while to continue to enjoy it by oneself. But it never will lose currency with the world, in spite of momentary appearances; it never will lose supremacy. Currency and supremacy are insured to it, not indeed by the world's deliberate and conscious choice, but by something far deeper, — by the instinct of self-preservation in humanity." *

Too often we have heard the fatuous cry, "Art for art's sake." What we want is art, not for art's sake, but for man's sake — for the sake of "sweetness and light." Life is too much debased and defiled; what we need are knowledge and enthusiasm, innocent delight and strong principles, exaltation and ennoblement. If all writers do not give us books to meet this need, there are many who do; and to these only we ought to turn.

No man need be in doubt about what to read. Mr. Stopford A. Brooke's *English Literature*, and that of Mr. Henry S. Pancoast, and Mr. Brander Matthews' *American Literature*, will serve as guide-books to the best that our literature in prose and verse affords. And to these may be added Professor C. T. Winchester's *Short Courses of Reading;* Professor Richard G. Moulton's *Literary Study of the Bible*, and *Four Years of Novel Reading;* Miss Harriet L. Mason's *Readings and Questions*, which may be had bound in the same volume with Mr. Brooke's *English Literature;* Professor Welsh's *English Masterpiece Course;* or Miss Mary E. Burt's *Literary Landmarks.* All of these books, or any one of them, will give such information as a would-be reader may need.

Whatever we do, let us not forget the noble company of the best writers, "so numerous and so gentle," waiting round us all day long to gain our audience — "kings and queens," as Mr. Ruskin calls them, "lingering patiently in those plainly furnished and narrow ante-rooms, our bookcase shelves."

Let us remember that the best things in our literature are all at our choice, and that life is short; that, if we read this, we cannot read that — that what we lose to-day we cannot gain to-morrow. Let us remember Mr. Ruskin's ringing question:

* xlvi.

"Will you go and gossip with your housemaid or your stable-boy, when you may talk with queens and kings?"

He who never reads never can know with what depth of passion, and yet with what infinite patience, the best in life waits for him, and beckons him. I suppose that no man ever yearned toward the best in life, so longingly as the best in life yearns toward him.

Through books out of the heart of the Infinite, in ten thousand things of strength, of beauty, and of gladness, comes our immortal summons. Some new echo of this cry, however faint, I wish that we might hear to-night; and, hearing it, I wish that we all might resolve not to let a single day pass without affording us, for at least some fraction of an hour or of an evening, something more of the wondrous instruction and inspiration to be had from the study of the English-speaking people, their language, and their literature. And I wish this, not for ourselves alone, but for the mental, moral, and spiritual upbuilding of the strangers, both within and without our borders.

The greatest responsibility rests upon us. The improvement of a nation must depend upon the improvement of the individuals who compose it. In the past, it has not been the great mass who have permanently changed policies and determined destinies, but a certain smaller group of influential individuals. We may take heart from this.

In his inaugural address at Amherst (October 11), President Harris said: "Ten men of culture living up to their standards, speaking correct English, promoting education and religion, are enough to save any Sodom in which they dwell from its coarseness and vulgarity."

If this be true, a thousand such men in a hundred communities are enough to save our State; it will not take a hundred thousand to save our country; and if, as English-speaking people, we become great enough in the transcendent nobility of our righteous, beneficent, and joyous life, it may be for us to help immeasurably and decisively to save the world. And then, as in the wondrous apocalyptic vision of the seer of Patmos, it may be said in heaven, "There shall be no curse any more," and of us it may be written that the leaves of our tree were "for the healing of the nations."

Secretary GOLD. I want to say a word or two in regard to the subject of this lecture. When the speaker was talking

I thought what curious work we do make with some of our common words in the English language. Very intelligent people hopelessly mix up the two words "learn" and "teach." Those are words that we are using every day, and in use almost everywhere. You hear about the teacher learning the scholars so-and-so. It is a very common way of speaking. Do let us be careful about such little inaccuracies of speech, and learn to say exactly what we mean. And then I want to have the reporters and printers understand that as farmers we are "agriculturists," and not "agriculturalists." We see in the press often that they call us "agriculturalists." They put in the additional syllable. It was bad enough for the old Romans to call a farmer as they did, "rusticus." Now it is about as bad to call us "agriculturalists" as it was to call us by the old Roman name, adopted in English as the proper one for a farmer. I will not take up the time on this subject of words, but it is a wonderful study if you will only go into it and see what a wealth there is in language properly used, and what fearful errors in speech are made by carelessness. You can get all the lawyers you are a mind to to write a will and two or three more of them will tear it all to pieces because of its indefiniteness or ambiguity. Is it not about time that we had the study of English so thoroughly mastered that these things could not be? We are in a transitional state, going on all the while toward better things. We are not drifting backward in this matter, as we see when we recall the forms of speech as used by our good grandmothers and grandfathers. The prospect is hopeful.

The PRESIDENT. Only for the lateness of the hour I wish we might talk considerable about this evening's address. It is something we need to think about and carry with us. It is something very suggestive and important. And, more than all that, it is something exceedingly beautiful. Think of language. Think of its power, and think of what it may teach us. Think of what it may do for soul and body.

[Convention adjourned to Friday, December 15th, at 10 A. M.]

MORNING SESSION.

Friday, Dec. 15th.

Vice-President E. G. SEELEY. To accommodate the speakers a change it made in the order as given in the program. I take pleasure in introducing Pres. George W. Flint of the Connecticut Agricultural College.

WORK OF THE CONNECTICUT AGRICULTURAL COLLEGE.

BY PRESIDENT GEO. W. FLINT.

The sum of the work done in any institution is not easily estimated, since the amount actually accomplished is difficult of anything like exact measurement; and its results, if commensurate in any degree with our earnest hope and expectation, are far reaching, and of ever-increasing moment, not merely in individual experience, but also in civic life.

No difficulty is experienced in setting forth the aims and purposes of instruction, or in unfolding the methods by which success, it is hoped, may be attained.

Nor is there any difficulty in tabulating, in satisfactorily imposing columns of figures, which, to some minds, carry conviction by their very form and the intricacy of their arrangement, the number and character of experiments performed, the elements employed in each, and their several results.

Neither is it a difficult task to recount the number of insects impaled, the several particulars of genus and species, together with a satisfactory exposition of the character and habits of each.

Then, too, a summary is impressive, when it sets forth in manifold detail the number of hours per week assigned to each of the various branches of learning, the several courses of study, the number of lectures delivered, and so on through the list of those particulars which go to the making up of such summaries in general.

It is well, to be sure, at this point, to note the difference, in respect of summarizing results, between the experiments of the laboratory, where everything is done with mathematical nicety, and the mental effort made in the study of English

literature, the study of economics, or in the line of historical research.

It has, however, seemed to the speaker that, instead of a rehearsal of the details suggested, a discussion of the relation of our work in its broader sense to the growth of the individual, and to the larger questions of civic life, would be more interesting, and, perhaps, more valuable, as giving a wider outlook upon our connection with the movements of the times.

Let me ask you, then, to suppose that, as heretofore, we have been earnestly and heedfully giving attention to the instruction of our youth in agriculture and its kindred arts.

I am glad, too, to be able to ask you to accept our statement that during this and previous years we have gained a clearer view of the limitations as well as the extent of the field assigned to us for exploration; that we have, in consequence, obtained a firmer grip on the methods best adapted to our students; and, finally, that our year's work will upon analysis prove, as it ought to prove, in the line of advancement; yet with plenty of horizon before us.

Supposing this all true, then I would like, with your consent, to consider the relation of such education as it is our duty to inculcate, to the citizenship of the commonwealth and the best interests of the community.

There is a certain unfortunate vagueness in the use of the term college; and, in general, in the nomenclature of our institutions of learning. For example, more than one institution can be found in the country, which, with a single academic department, advertises itself as a university; and our business schools, well conceived and excellently conducted as they are, expand under the name of "Business College," which name they use with as unruffled a front as Yale or Harvard. Therefore it seems to me that the atmosphere would be somewhat cleared if, as in Germany, we had a separate and dignified title by which to describe what the Germans call "Real-schule."

It is, and properly so, the claim of those time-honored foundations that until recently have held a monopoly of the title of college, that it is their privilege to prepare our youth, not for any one vocation, but for the best and noblest life attainable in any vocation. I use the term vocation in preference to profession, because whereas formerly men generally sought an education as an avenue to a profession, they are in rapidly

increasing numbers seeking the training commonly called a college education as a preliminary to business.

If then our greater colleges worthily use their opportunities, they are indeed training their men for success in the highest sense in any calling. And the result of such training as shall store the mind with the best and richest in literature and art, and, before the stress of active life shall cut off opportunity, shall enrich the mind with the stores of history; and, establishing as the best and most satisfactory ends of life lofty ideals in private, domestic, and civic life, such training, if increasingly successful, must go far toward the bringing in of higher standards of life, both in the home and in the community.

Surely this is a noble ideal, a lofty inspiration, and in the main it may be said that the clear recognition of such opportunities and responsibilities is of itself a large guarantee that these time-honored institutions will worthily fulfill their purpose, — a purpose all the more valuable, because of the bald materialism of our modern life.

And can we of the humbler Connecticut Agricultural College, whose very existence hangs in the balance of legislative caprice, whose retired and quiet seat amid the hills of Tolland is the passing jest of the thoughtless, and the excuse behind which lurking hostility shelters itself; whose arts, redolent of the soil, are the scorn of the indolent, and point the clumsy wit of the would-be jester, whose vituperative clamor fills the air and is too often mistaken for a virtuous zeal for the commonwealth, — can we, then, claim no share for our work in the great sum of modern educational achievement?

Professor Thompson in his Political Economy says: "The importance of education as a part of a wise national economy is not hard to find. The small outlay of the national resources that is necesary to train every citizen to the highest rank in industrial efficiency that is possible to him, is well expended in the purchase of a larger gain to all classes. It is one of those wise sacrifices of present for future advantage, which distinguish progressive societies from those that are stagnant."

The Connecticut College of Agriculture and the Mechanic Arts is essentially the product of what may be termed the most modern idea of education. Perhaps that idea is not the less

sound, because it is, at the same time, the most ancient idea of education.

So long as the majority of mankind must of necessity find their sphere of life and painful activity in purely industrial pursuits, and so long as the period of preparation must be correspondingly brief, so long, it is clearly evident, must the classic doors behind which this enriched and altruistic life I have mentioned is attainable, show only their cold exterior to the vast majority, to whom "*res angusta domi*" forbids entrance.

Years ago the majestic strides of our mechanical progress with its wonderfully inventive arts forced the reluctant colleges to the bar to defend their time-honored curriculum, — an inheritance, be it said, not of the clear, practical ideals of the ancient world of thought, but rather from the mediæval fog of monastic scholasticism.

Still, the rise of the university was so very gradual that its steps can hardly be traced, but when Abelard was drawing tens of thousands of students to Paris to hear him expound the scholastic philosophy, the university had taken a distinct shape, which was changed chiefly by the division of the professors into separate " faculties," and the students into " nations "; and this formed the model after which others were erected in Bohemia, Germany, Spain, and Scotland. But these institutions were not instruments of popular education. They attracted, however, an immense body of students to a few great centers of culture.

Their object was to form a learned class, not to reach the whole people. He who received it betook himself to a new sort of life; he did not go to the schools to learn what would fit him to fill his place in the class in which he was born, but to leave that class and enter another.*

Ancient Greece had two methods of national education. There was the Spartan system of military discipline, and stern, unnatural restraint. As one writer has clearly said, " It was the drill of an armed garrison who gave up their individual tastes, ideas, and impulses, and submitted to an all-constraining law. The death of the three hundred at Thermopylæ, in obedience to the laws, was the crown and the flower of the life of the city, which produced no great men of letters, and, indeed, few great men of any sort. While on the other hand the

* Thompson.

Athenian method was a full and free development of human nature, especially on its intellectual and æsthetic sides." Continuing, he says, " In Athens, more than in any other land or time, we have the results of the extension of the finest culture of mind to the whole free population of a state. Of formal teaching and learning there was comparatively little, except the memorizing of Homer and other poets in the schools; the new science of mathematics seems to have taken its name from the fact that it was the first branch of knowledge that was not picked up — like reading, writing, grammar, politics, and the arts — from one's fellow citizens, from being at the theatre, or from the daily contemplation of great works of art, etc.; but needed to be learned by direct and formal application. Yet their intellectual education was perfect; no accumulations of knowledge or improvement of methods have enabled any people or class to attain a higher or more balanced cultivation of mind. But they lacked moral balance and self-restraint, and so became the victims of their own cleverness.

" Now, if the teaching of the New Testament be true, both of these opposite methods were right, and were capable of unification, because there is in man a higher or spiritual nature which education is to awaken into life and call forth into activity and vigor; while there is also in man a lower or animal nature by which he must not be governed, and which must be brought under restraint and discipline."

Begging your pardon for this excursive digression, I said the colleges were forced reluctantly to defend their time-honored curriculum. The result that followed this defense was the establishment of so-called scientific schools, which, discarding the humanities, sought to train men directly for the pursuits of active life.

Who shall say that this training was less effective even in so-called professional life, or deny that it has its peculiar advantages in some callings, particularly the law; or that it has failed in producing men whose ideals are as lofty, and the sum of whose achievements in civic life is as respectable as those bred more regularly beneath the academic shades?

Like these schools, it is our duty, along one of these most important—and, hitherto, the most neglected—lines of science, to lead and instruct our youth for active service in the contest of life. Like these other schools, to give them the best train-

ing, the sciences, our facilities, and their preparation will admit, and then conduct them to the very portals of the arena, where they are to engage in the struggle of life.

Unlike the older colleges, mere mental training and that quality commonly called and vaguely described as culture are not formally included in our scheme of education, or, if present, are recognized in a vague and secondary way.

I do not draw attention to this difference in the fundamental conception of education for the purpose of criticising either the one or the other. The difference, however, is necessary in view of differing needs of different classes of men. Much less do I speak of it to deplore the conditions under which our work is to be done; for it is clear that in the hurry and stress of modern life — and I leave it for you to consider whether under existing social conditions that stress will be less severe in the twentieth century — the education of the vast majority of men and women must needs be more and more practical, — that is, along lines which will equip the tyro for immediate usefulness in the world of industry.

Nor is it true that education is to be found only in arts remote from common life. The equipment of our high schools with facilities for shop work — "the education," as its exponents call it, "of the hand and eye," is a clear and systematic movement in the direction that holds that an educated human being should be *something* — able to do *something*, to contribute *something* to the industry of the world; not merely after twenty years of costly training to be just ready to learn to do something.

The ancient Jew established a school in every neighborhood, beside every synagogue; and besides the education given him, every boy had to learn a trade, "so as to provide against all contingencies of fortune, and enable him to avoid becoming either a pauper or a thief."

Even our Lord served in a carpenter's shop; and, perhaps, the ability of St. Paul to make tents did not abate the zeal nor diminish the eloquence with which he instructed the brethren of Corinth and Philippi, and, in the midst of Mars' hill, preached to the learned Athenians the "Unknown God," whom they ignorantly worshiped.

Granted that philosophy and the humanities constitute a means of the highest culture for those who have the time and

money — and let me add, as a very considerable desideratum — the inclination to attain it; surely it does not follow that they are the only means.

Nor does it follow that the subject matter of an education, which turns out men ready to do something in this world, whether it be on the farm or in the shop, are *ipso facto* absolutely unproductive in that higher training, that more generous culture to which we have before referred.

For example, what training can you conceive that shall inculcate a profounder love for truth and sincerity or a deeper respect for law than the study of such natural science as is today the fundamental training in institutions like our own? Carlyle points out in more than one brilliant period of rhetoric the make-shift and temporary nature of all that is false and untrue in society and in government, and shows how infallibly it is exposed in the eyes of all men.

To whom is that lesson more forcibly brought home than to the youth who in his laboratory marks the infallible, the steady, exact, and remorseless working of chemical or physical law?

Surely he has a sharp commentary on moral law and upon human conduct when he discovers that nothing can be lost, and to the trained eye of research nothing can be hid; that no factor is put into his problem which he does not find there in the last analysis; when he learns that in God's great laboratory no lie may stand, and no element appears that was not placed in the crucible; that no factor may be concealed nor fail to work its legitimate consequence.

Nay, it may be found that the very central subject matter of our instruction, agriculture itself, when its true place is determined, may, to quote another, "be seen fit for a prince's bride, and no longer the neglected and ragged and despised servant of her sister arts."

It is difficult to conceive any pursuit that can bring man more into communion with nature than the careful study of that group of sciences directly related to the culture of the fertile earth beneath our feet. What is there more wonderful than the productive power of the brown soil we tread; the mysterious regeneration and resurrection that will gladden our eyes and cheer our hearts a few weeks hence?

"Whenne that Aprillë with hir showrës swote,
"The droughte of Merche hath percéd to the roote,
"And bathéd every veine in swich licóur,
"Of which virtúe engendrëd is the floure;
"Whenne Zaphirus ekë with his swotë brēēth
"Inspiréd hath in every holte and hēēth
"The tender croppës, and the youngë sun
"Hath in the Ram his halfë course y-run,
"And smallë fowlës makë melodye,
"That sleepën all the night with open eye."

Nor need we fear that a deeper, a closer, and more scientific study of these apparent miracles of nature will take away anything of the charm they have always possessed for reverent souls. The ancient could do no better with them than to idealize them under the charming myths that form the fairy stories of our childhood. Nor is their marvel lessened by the microscope and the chemical reagent of these modern days, but rather do they speak more clearly to the mind of the earnest student.

Moreover, in such study is bred a habit of close observation; freedom from prejudice, as the mind finds itself competent to form a judgment; a readiness to accept whatever process or conclusion points out as valid. Then, too, there is added a certain alertness of mind, a facility which enables the individual so trained by a sort of transfer of habit to seize readily upon the decisive factors, the controlling elements in problems of other kinds, as, for example, the vexatious and harassing questions of civic life; a kind of sturdy looking at the principles of action, noting their relation, and thus reaching a conclusion as sound as that reached by the more generously cultured man by the excellent old process known to the New England farmer in his best days as the application of common sense.

And may I here digress a moment to suggest that we too often overlook the frequency with which the common sense of the plain people, even upon the more intricate problems of national policy, disables the judgment of the learned and accomplished who would lead them?

We do not forget the Hartford Convention, held almost at the time when McDonough, a citizen of Middletown, who was not in attendance upon that body, was engaged in other business far away on Lake Champlain.

Nor yet the poetic strains in which so accomplished a man of affairs as James Russell Lowell set forth the coming ruin of the republic, because of the Mexican War. In fact it is one of the marvels of history that, upon questions which touch deeply national consciousness, the judgment of the plain, uninstructed people is quite as likely to be correct as is that of their more accomplished leaders. So in '61 the war for the Union was waged without a thought of the destruction of slavery or of hostile aggression upon the south.

"The Union as it was" was the determination of statesmen and constitutional lawyers of the day. Yet the boys of '61 started in from the beginning with the exact truth clearly perceived and expressed, when they marched away south with the song "John Brown's body" ringing from their lips, for John Brown embodied an everlasting extirpation of slavery, and a ceaseless aggression upon its defenders. Perhaps no body of men ever assembled that grasped so comprehensively their relation to the past, or saw with clearer vision the trend of their own times, or built so solidly for the future as the fathers who framed the constitution.

Yet almost every master mind among them brought to his task only the training gained in practical affairs.

Still, as I have said, few men have ever looked out upon the world around them with a clearer apprehension of the nature and scope of the task imposed upon them, or more clearly apprehended the principles involved in its successful accomplishment.

But "to return to our muttons," why is it that the young people who grow up on the farm learn to regard agriculture as a soulless, mindless routine of hard work, with no chances of using any higher power than the muscles, and hence carry their brains to the best market, entering other professions, all of whose lines of activity are crowded with men of more or less intelligence and mental power?

I am sure that no thoughtful mind will deny the proposition, that in any proper sense there is no more rational and inspiring study than that group of sciences which collectively form the study of agriculture in its entirety.

Of its relative importance nothing need be said, since the pages of the United States Census sufficiently demonstrate that; and I hope I have shown you that it contains, too, the

elements of that higher culture for which we all strive, so that any youth whom choice or the necessity of an earlier preparation for active life brings to our doors, not only will not find himself entirely bereft of all the influences which in education make for "sweetness and light," but will also find himself possessed of qualities ready trained to attain success in life.

I use the expression, "success in life," in its narrow meaning here. For, while I do not wish to be understood as bowing down to the dull materialism whereof our teachers and preachers speak often and again, yet I deem it important for the conservation of the best citizenship in our State, which our youth should be taught to look forward to, to prepare themselves for, to strive for the highest success attainable by honorable means. Indeed for the man who is unsuccessful, no matter how deeply versed in philosophy or how skilled in art, there is no πὸυστῷ whence he may move the world about him.

So, then, that education which deals directly with the work in which the student intends to exert his efforts may, after all, prove the best for the majority of the wage-earners.

And we need not fear lest we shall err on the material side, if we train our youth to the idea that the battle of life, if rightly and honorably conducted, ought to give rewards commensurate with the arduous effort required for the struggle. Perhaps, too, our love of the dollar is sometimes exaggerated, our materialism too much an object of dread, when more and more it is a matter of surprising comment that the dying multi-millionaire has forgotten to endow some noble charity, remember some mission of the cross, enlarge the facilities of some great university, or enrich the life of his own community by establishing a princely library or a glorious gallery of art; when men are beginning to think that money, like other forms of power, is a trust.

It may be remarked in passing that many, if not most, of the men

> "Inventas qui vitam excoluēre per artes,
> "Quique sui memores alios fecēre merendo,"

(who have improved life by their inventive arts, and have made others mindful of themselves by their service), have been men of practical education, but who, perceiving the real source

of power in our time, have seized it firmly, used it worthily, and transmitted it nobly.

So that, as I have said before, we must strive to put into the hands of our youth the means for obtaining an honorable success.

But there is another side to our work, which is supplementary to our central idea, and which I wish briefly to discuss. If we are to take our place among the higher institutions of the State, a position assigned by a standard which takes into account only the multitude of languages therein taught, then is ours indeed a humble place. No Greek, no Latin, nor modern tongue, nor Oriental language enriches our plain and every-day curriculum. Nay, even the pious motto which adorns the title page of our catalogue appears like a belated and lonesome survival of an elder day. All our instruction is given and received in plain English. But we are not to be understood as being greatly troubled therein; for, although we believe there is no linguistic training that can be compared to the study of the classic tongue, yet we see no reason why a systematic study and practice in the elements of grammar, — I mean grammar, not a make-shift language exercise, — should not lead to exactness, and even elegance in the use of the mother tongue, and that too without the aid of any foreign language.

In these days of a universal outcry for better instruction in English, I need not suggest the importance of this branch of study; nor need I say anything of the universality of the literature to which the English language is the key.

Neither do I need to speak of the value both to the citizen and to the State of the convincing power of clear and precise English.

One of the sources which gave to Themistocles the ascendant by which he reached an eminence, where his transcendent genius might save the State, is thus set forth:

"Celeriter, quæ opus erant, reperiebat, et facile eadem oratione explicabat"; and no less stress is laid by the ancient author whom I quote upon clear speech than upon clear thinking. In fact, I may say there is no surer way of reaching the habit of clear thinking than the habitual practice of clear and exact expression.

As one writer says, "The intellectual growth of a nation is

chiefly from within, and the attempt to import a foreign culture by wholesale can result only in crushing out that which is of native growth, and in retarding the normal progress of the people. It will merely root out the native plants, and substitute a *hortus siccus* of dry and dead specimens without sap or root. For every country possesses a certain average of intelligence, and has attained a certain stage in the great historical march of the human spirit from childish subjection to manly freedom."

Here, then, is a means of cultivation, that with the aid of literature, may do much to place the work of what the Germans call the "Real Schule" upon a plane nearer the college.

For all history lies open to the careful student of history; all science and the work of the master minds of all time. And when we shall have inculcated the habit of sound reading, even though the student be shut up to the English language, he has, if he be well grounded in the elements, the means at hand of cultivating his mind and his power of expression almost at will.*

That a broad training in English is demanded is evident from the curricula of all our colleges. Yet it is only within a few years that our mother tongue has begun to receive the attention so noble a language deserves; and when to a sound training in English shall be added something of skill in dialectics, we shall have contributed much to the higher culture of our students; and they will then possess the ability to express plain, common-sense thought consecutively and in forcible language; the kind of persuasive speaking that, founded upon clear apprehension, shall enable our young citizen to benefit his community and his State, by getting his excellent ideas before the town meeting in such clear-headed fashion that they will be adopted as the natural and proper thing to be done.

Now, at the risk of wearying your patience, I feel that I should not do justice to the work which a college is set apart to perform unless mention be made of the study of civics, which, in its larger sense, we call the science of government, without too much stress being laid upon the details of government. Here, too, is a broad and useful field for study.

For it might be observed, as we compare modern with ancient times, the progress we have made is much more striking on the material side of our civilization than upon any other;

* Hist., Science, and Lit.

and our knowledge of what might be called a science of government, at least so far as its practical side is concerned, has not made advances commensurate with the material side of our civilization. And while we have an infinity that is new in science, both pure and applied, the same old vulgar arts of government still prevail. The senatorial ring at Rome had nothing to learn from the " credit mobilier " of our own times; nor did Cleon the butcher at Athens need to go to school to the modern demagogue. And certainly no one will say that the illustrious galaxy of bosses who adorn and give color to the local political life of our metropolis could very well give lessons to the first Triumvirate.

It is true, no doubt, that republics are peculiarly subject to such evils and perversions as are here suggested, and since we have reached the belief that government is a human institution, we must believe that, like other human institutions, it is characterized by imperfection.

Thus, perhaps, some may easily conceive that a well-ordered monarchy is free from some of the ills of which we are acutely conscious. Yet, perhaps, too, the subjects of such a monarchy are as acutely conscious of ills, but of another class, which we do not experience. And since our fathers, with the choice of monarchy before them, wisely as they *thought*, and gloriously as we *believe*, established a republic for us, we, perhaps, might expect that upon us would be laid the necessity of conserving that which is best, and of battling against the ills which might be supposed to exist under a republican form of government. And so in this larger sense, which teaches reverence for the institutions entailed to us, belief in their efficiency, and confidence in their power to subsist in their integrity, however great the burden we are called upon to carry, and however far our destiny may lead us, we believe that we, in so teaching our youth, are worthily fulfilling our duty toward them, and toward our commonwealth, and the whole country.

In addition to all this, I would like to suggest also the importance of some knowledge of economics. Questions of trade, of transportation, of exchange, as well as production, — all these are of vast importance to the future agriculturist, both as informing him of the actual condition and necessities of the country, and enabling him as well to distinguish truth from fallacy in the catch-words of political platforms.

Some knowledge of the tendency of the times that leads capital to combine into great trusts, some idea of patient investigation into the complex relations of our modern society; some idea that may be at the bottom of all these things, subsist laws, which may be detected by their subtle operations, and be made to work in harmony with the best interests of the State.

Our young farmer under these circumstances will be much more likely to be a careful student of the intricate relations that exist in any highly organized state of civilization, than to be in haste to follow the lead of demagogues who propose cheap dollars as the panacea of all our political ills. And will thus become a conservative and law-abiding citizen, and will justify the wisdom of those who believe in the necessity of practical education for success in agriculture as well as in the mechanic arts.

It will be noticed that I have said nothing heretofore concerning the absolute necessity of a more scientific study and application of the arts to agriculture, to bring this great basic industry from that state of stagnancy into which it has fallen back to a position commensurate to its importance with the "Mechanic Arts."

It is not because I am not thoroughly convinced of the truth of this proposition, but because I may take it for granted, since the farmers of the commonwealth have moved for the establishment of such an institution as the Connecticut Agricultural College, that the need of such instruction and the advantage to be derived from it is clear and undisputed.

In conclusion, then, a popular education should be:

(1) One that will develop in the student the powers and capacities of mind that fit him to understand the ideas and the truths that are common with all his fellow citizens, and one that fits him to act with at least an equal degree of mental freedom.

(2) This education should be one that shall impress upon him the characteristics of an upright and good citizen, a man of public spirit, a devoted patriot, and a true philanthropist, and that prepares him to exercise such political powers as are intrusted to him by the constitution.

(3) It should be an education that will give him such general instruction, and offer him the privilege of acquiring such special training as will fit him for his special calling or

industry, and will enable him to pursue that calling in the most effective manner.

The PRESIDENT. Discussion is deferred till the afternoon. I will now call upon Dr. E. H. Jenkins of the Connecticut Experiment Station.

THE LAW REGARDING COMMERCIAL FEED-STUFFS.

By E. H. JENKINS.

I do not propose at this time to give an account of all that the Station has done the past year, but, instead, to call your attention to one particular thing, namely, the new law regulating the sale of commercial feeding stuffs, which places certain duties on the Station, on the Dairy Commissioner, on the feed dealers, and, in addition, a moral obligation on all those who buy feed. The Station is doing its duty in the matter. It will shortly issue a bulletin giving the results of our work thus far; the feed dealers are beginning to do their duty under the law. I want now very briefly to call attention to the opportunity and the duty of feeders of stock to make this law a help to them.

The law is the result of a movement within the Grange; its passage was secured largely by the efforts of prominent members of the Grange. It is therefore a farmer's measure.

It is a sound law, fair in its provisions, and, like the fertilizer law, capable of benefiting honest dealers and purchasers alike. But, on the other hand, it may do no good whatever, and be only a nuisance. Whether it proves helpful or useless depends very largely on stock feeders themselves; those who buy and use commercial feeds. Any such statute to be effective must have sound public opinion behind it, must be well understood and fairly used.

Notice the provisions of the law. It covers all commercial feeds, excepting hay and straw, whole seeds — like wheat, oats, and corn — and unmixed meal or flour made from wheat, rye, corn, oats, or other grain.

With these exceptions (hay, straw, whole grain, and unmixed meal), every lot or parcel of commercial feeds offered for sale must bear a label giving the name of the feed, number of pounds in the package, name and address of manufacturer or dealer, and a statement of the percentages of crude protein and crude fat contained in it.

Failure to comply with the law renders the dealer or selling agent liable to a fine not exceeding $100 for the first offense, and not exceeding $200 for each subsequent offense.

The Connecticut Station is authorized to draw samples from any lot of feed in the possession of any manufacturer or dealer — under certain restrictions — and is required to make at least one analysis annually of a sample of each brand thus collected, and to publish these analyses with appropriate discussion. When it is clear that the law is being violated, the Dairy Commissioner is to prosecute. This law went into effect July first. Such is the law.

The substance of it is that the seller of feed must in each case state what he is selling, and how much protein and fat there is in it.

It is pretty clear, is it not, that if those who are buying feed in any quantity know what protein and fat *are*, know their use in cattle feeding, know how much of them is needed for their purposes, then this law is very helpful? But if they do not know these things and do not care to find them out, the law is of little value.

Of what use is it to know that an oat feed has only seven per cent. of protein, while wheat bran has seventeen, if the nature and use of protein are not understood? It is as futile as the discussion of financial problems, so common now-a-days, by " statesmen " who have no clear idea of what money is and see no trouble in using two yard-sticks of different lengths, and in promises to pay instead of payment.

Under the law, certain frauds in feeds may be detected, exposed, and driven out. But this is not the main trouble. At present there are very few really fraudulent things in the feed market. One main trouble has been with low-grade, " cheap " feeds, offered at attractive prices, which are no better than oat chaff, and with the fact that the buyer had no ready means of finding out the real nature of the feeds offered to him, whether they were rich or poor in protein.

This question, then, is up to practical feeders. Does it help you materially to know just how much protein and fat your boughten feed has in it, and if not, will you make the effort to find how such knowledge is helpful?

It is a tolerably simple matter. It may be worth while to go into it very briefly here.

Why do we meddle with bought feeds at all?

Certainly not because the *quantity* of cattle food raised on the farm is insufficient. Most farmers can raise enough and more than enough corn fodder and straw and corn meal and hay to feed the stock which is on the farm. There is enough bulk of feed, enough weight of feed, enough of almost everything, yet all feeders — or nearly all — buy feed.

Why do they do it? Because they all know that it adds something which is always lacking or insufficient in home-raised feed, and many of them know — a constantly increasing number, I trust — know that this something is digestible protein. It is that which is relatively lacking.

Two great defects of our present farm management are that too little care is given to raising crops rich in protein, and that, as a rule, too little protein (nitrogeneous, flesh-forming matter) goes into the food of our stock. With insufficient protein the stock produces less beef or milk than it would otherwise, and the other nutriment of the food, sugar, starch, gum, etc., is in excess of the animal's capacity for assimilating it, and so passes through the body undigested and gives little value to the manure.

Observation and careful experiment have taught us, in a general way, what a cow needs daily — of digestible food ingredients, of dry matter, protein, fat, and non-protein — to keep her in good condition and maintain a full flow of milk.

We also know that the necessary quantities of flesh-forming and of heat-producing nutrients cannot be supplied *in proper proportion* by either hay, corn fodder, corn stover, corn meal, corn ensilage, or any possible mixture of them. If you feed the right quantity of starch and sugar, or heat-producing nutrients, as we may call them, the ration has too little protein or flesh-forming matter. If you attempt to supply all the protein which the stock needs — in order to give the most milk or beef production — in these home-grown foods exclusively, you put before your cows more coarse fodder than they can

get down, and more starch and sugar than they can assimilate. You waste your feed and at the same time underfeed your stock.

I cannot now go into statistics and statements of chemical composition and percentage digestibility. That may be done in a forthcoming Station bulletin. The main outline of the argument is what I want to emphasize now, namely: We cannot make a suitable ration for milch cows, let us say — one which will keep them at their best in milk production — on any feed or combination of feeds which most of us raise on the farm.

The trouble with all these feeds is that they are deficient in digestible protein. Hence we must buy protein for two reasons: first, to make our ration tally with the cow's requirements, *i. e.*, to "balance the ration," and secondly, to save waste of our home-grown feed.

Feeds *rich in protein*, then — at all events, feeds richer in protein than those grown at home — are what the feeder should buy. All feeds contain a considerable amount of non-nitrogenous matter, non-protein, like starch, sugar, and gum, but those rich in protein are what are most wanted, and generally speaking, most profitable to buy.

The farmer is not in the feed market to buy any old thing which is a manufacturing waste and must be burned under the boilers to make steam unless it can be ground finely and sold to him as a compound cattle food. He is not there to buy *anything* because it is cheap. Protein is what he should seek after, digestible protein at the lowest price.

Within the year the Station has examined chemically, and for the most part microscopically, too, more than two hundred samples of feeding stuffs drawn from dealers in this State. So we have had under our hands most of the various brands which are sold here.

It is worth while to go over some of them in detail and to correct some misapprehensions regarding them.

First there is COTTON SEED MEAL, ground from the hard pressed cakes of decorticated seed which have been subjected to hydraulic pressure to remove the oil. There is no other feed — which is on the market in large quantity — that contains as much protein as this, over 45 per cent. on the average, nor, considering its feeding value, is so cheap. Because of its high

percentage of protein, because of its very goodness, it has to be fed carefully, never by itself, and never if it is not bright, clean, and sweet. "Off color" meal should never be used as feed. Neither should the low-grade, unhulled meal be bought, which sometimes finds its way into the State. I know that it is used as feed abroad and at the South, and with good results, but why pay freight on hulls and lint? It is urged that it is a safer feed than the decorticated meal, which is true. So are oat hulls safer. But the prime, clear, yellow meal is safe in the hands of an intelligent feeder, and any other kind of a feeder will make a mess of the business, anyhow.

LINSEED MEAL is prepared by two processes: by the "old process" the oil is removed from flax seed by pressure, by the "new process" it is taken out by a solvent like benzine, and the meal is then cooked to remove the last traces of this solvent. Old process meal has about 35¾ per cent. of protein and 7¼ of fat, and new process linseed meal (such as is put out by the American Linseed Company) 38¼ per cent. of protein and 2¼ per cent. of fat. It is a more expensive feed than cotton seed meal, but is less likely to cloy and make trouble if carelessly used.

The GLUTEN MEALS and GLUTEN FEEDS are popular cattle foods which some dairymen are afraid of because the statement is made that chemicals are used in their manufacture and remain in them. This objection is unfounded. All these articles, Chicago gluten, cream gluten, King gluten, Diamond gluten, and the gluten feeds are made by practically one method of treatment, which is this: We may regard the corn kernel as made up of four parts which have to be separated. The husk or hull on the outside of the kernel, the gluten, a horny material below it, the starch, which is the basis of the glucose manufacture, and the germ or chit. To separate the kernels into these four parts the corn is soaked for twenty-four hours or more in water containing a little sulphurous acid, the only chemical used in the process. It is then crushed and ground in a stream of water, between stones, running high. This detaches these four parts just named, and leaves them all suspended together in water milky with the starch. This starch water is kept at such a concentration that the chits or germs, which are very oily, float while the other parts sink. The chits are skimmed off, dried, pressed to remove the corn

oil, which is sold to soap makers and dressers of leather. The germ cake is ground and sold by itself or mixed with other corn products. Next, the matters which have sunk in the starch-water are reground and run over sieves in a stream of water. The corn hulls, husks, or chops are held on the sieve, are dried, and also sold as cattle food. This leaves in the water the gluten and starch, which are run over settling tables, where the starch sinks and stays, while the lighter gluten runs off and is finally caught, dried, and ground. This is the "gluten meal" of commerce. What the manufacturer is after is the starch, from which glucose sugar and syrup are made. The other things are for him waste products. In all this, as you see, the only chemical used is a little sulphurous acid, which is completely washed out by the very large amount of water used in the process. Some factories mix the clear gluten with the corn chop or hulls and sell the mixture as "gluten feed." Some put back a part of the expressed corn oil into the feed, or perhaps mix germ and gluten together. In this way there results a considerable number of gluten feeds and gluten meals, no two of which are alike in chemical composition. Even the same brand is not alike. For instance, "King gluten" is made at two mills, Des Moines and Indianapolis. That made at the Des Moines mill has about 33 per cent. protein and 15.35 per cent. of fat — a high percentage — while the product of the Indianapolis mill has 34½ per cent. of protein with only 4.8 per cent. fat.

One brand of gluten meal, made at Westport in this State, has 49 per cent. of protein. On the other hand, Diamond gluten has only 23.6 per cent. Surely some statement of composition is necessary here unless we are willing to buy "a pig in a bag."

Next in order of richness in protein — and I believe in general economy to buyers — come the WHEAT PRODUCTS, bran, middlings, and mixed feeds. On the average, those made from spring wheat contain a half per cent. and upwards of protein more than those from winter wheat.

Brans contain less protein, on the average, than middlings by perhaps a per cent. and a half, while the wheat feeds, or "mixed feeds," are intermediate between them. Some mills dispose of their bran and middlings separately, while others put them together, making "mixed feed," and occasionally

there is added to this some of the lowest grade dark flour, called in the trade "Red-dog," which has as large a percentage of protein as either bran or middlings. It is interesting to note that "Red-dog" is not alone used as a feed, but is also used for making paste, and when mixed moist with leather scrap and subjected to heavy pressure makes what is known in the trade as "pancake leather," used for the soles of children's shoes. This puts an additional premium on keeping the feet dry.

The brans, middlings, and mixed feeds are tolerably uniform in chemical composition, though, as noted, winter and spring wheat products showed a difference, and of course the particular process of milling, as well as the grade of the wheat used, will affect the composition of the waste products. Nevertheless, in bran, as in everything else, avoid "great bargains." The bargain counter is generally the most uneconomical place to trade.

There are "cheap" brans on the market, selling for three or four dollars under the regular rates, and offered unobtrusively, which contain 25 per cent. or more of finely-ground corn cobs. A chemical examination will at once detect the fraud. The hard bits of cob may be noticed by chewing a little of the bran.

If there were no other feeds than these I have thus far mentioned in our market, the dairyman would have all that he needed to properly supplement or piece out his home-grown feeds, ensilage, stover, corn fodder and corn meal, and hay, or, as chemists say, to "*balance*" his cattle rations and to do it economically. There are other excellent and economical feeds which he can often pick up, bean meal, pea meal, malt sprouts, dried and wet brewers' grains, hominy feed, perhaps rye feed, and so on.

But let us turn now to some feeds which are found commonly in market, which have a ready sale, but which I question whether he can often afford to meddle with. Can dairymen afford, in general, to buy starchy cattle foods, those that have no more, or only one or two per cent. more, of protein than corn meal? I do not believe it. The farm ought to raise all the corn meal which the stock need, and it is very seldom that a man can sell his corn at a price which will make it pay to do it and buy in other starchy food. If he has corn meal a plenty

he cannot get on far in balancing it with anything which carries less than 13 or 14 per cent. of protein.

Look at the figures. Good corn, after it is well cured in the crib, has from $8\frac{1}{2}$ to $10\frac{1}{2}$, or an average of $9\frac{1}{2}$, per cent. of protein and 4 per cent. of fat, with about 68 per cent. of starch and a little woody fiber, and costs $19 a ton.

It will not, under ordinary circumstances, pay him to give $18 a ton for hominy meal, carrying only a per cent. and a half more of protein and 4 per cent. more of fat, either as a substitute for his home-grown corn or to piece it out, when he can buy, *for the same money*, good spring bran which carries over 17 per cent. of protein. A ton of bran gives him 340 pounds of protein, while a ton of hominy chop gives him only 220 pounds and costs nearly or quite as much. Protein is what he wants to buy on to the farm, not starch.

But look a little further. Here are the "oat feeds" from various mills, for the most part mixtures of refuse oats, the clippings and the hulls, and most of them only fit for feeding furnace fires or homeless goats. Some of them contain as much protein as corn meal with much less starch and much more fiber, but most of them are poorer in protein than any other feeds in market. One sample, selling for $15 a ton, contains less protein and fat and as much woody fiber as clean oat chaff selling for less than half as much, $7 a ton. Many of them have as much woody matter in them as hay, and I doubt if they are as valuable for feed. Yet they are "feed," "cheap feed," too. They are sold in every city in the State, and they are, *as a rule*, the most expensive feeds which one can buy.

Protein we want to buy, not starch, and not finely shredded wood.

Now it has not been my aim in this brief talk to discuss all the feeds which are in our market, or to discuss thoroughly any of them. Still less, to lay down any special rules for feeding. Every herd is in a way a law unto itself, and no hard and fast rules of feeding can take the place of the individual skill and experience of the owner of the stock and his constant watchfulness of the appetites, the evacuations, the general health, and the milk yield of each of his animals. Nor could I go into the matter of compounding cattle rations. For to do that one must sit down quietly with his pencil and cipher — or

stand at a blackboard and do it — if he will explain the method to others.

I only urge you to keep in mind the chief reasons for using commercial feeds, namely, to buy for the farm digestible protein enough to piece out the home-grown feed; that is, to "balance" the ration. And this balancing is necessary in order first to secure the maximum yield of milk, and, secondly, to prevent the waste in feeding of our farm-grown crops.

If stock feeders will study the composition of the commercial feeds they buy and be guided by the information which this law requires shall be given to them, the law will be a great help to the dairy interest of Connecticut. If they do not do this, the law will be worthless to them and only a burden to all others concerned with it.

A MEMBER. I would like to ask the doctor if he expects any great number of people in Connecticut are going to lose the benefit of this new law any more than they have lost the benefit arising out of the old fertilizer law, and if he thinks it is going to benefit the dairymen?

Dr. JENKINS. No, I do not apprehend that you are. I know that many of the feeders will not lose the benefit of it. What I have urged is that *all* feeders shall make a decided effort to learn the real use of the law. If they are not all informed so that they can make use of it they should exert themselves to get this information. Undoubtedly there are still a good many farmers who do not use the fertilizer law. I only urge that they shall make it as beneficial as possible.

Mr. TUFTS. I would like to ask if the common farmer is pretty safe where he does not understand much about these things. Take these substances that are sold for wheat bran, and that kind of thing. Do you think they are pretty safe to buy?

Dr. JENKINS. If you mean the possible contingency that such wheat bran as he buys is not wheat bran, I think, generally speaking, he is safe. A reputable dealer generally

knows very well what he is getting and what he is selling. The average of the dealers in the State have a reputation to maintain, and they are not in the trade for the purpose of committing fraud, but when a dealer is selling it under what anybody else can sell it for, there is room, of course, for suspicion.

Mr. PLATTS. We have to depend on the experiment station for our guide, but I have found in experience that if I buy first-class bran that I get bran. I sometimes amuse myself in a small way by examining things under a microscope. I am not a qualified microscopist, and do not know much about it, but I can tell dirt from flaked wheat, and if I get good coarse wheat bran I know I get that and nothing else. I have sometimes got fine bran which was sent to me, and I could distinguish what I should consider the sweepings of mills with a little sand and the natural dirt which would accumulate on a mill floor. I am not skilled at it, but that is my opinion, and I never have had any reason to change it.

Prof. GULLEY. Doctor, will you tell what this feed on the market is that is called "scorched wheat?"

Dr. JENKINS. I presume it is just what it pretends to be, fire damaged wheat; wheat that comes from an elevator that has been burned, or something of that kind.

Secretary GOLD. Why is it always a low-grade wheat? I never saw any first-class wheat that was burned. What do you say to that? I know it is generally sold, but I never yet have seen any first-class wheat sold under the head of burnt wheat.

Dr. JENKINS. I cannot explain that.

Prof. GULLEY. Is that a brand, or is it a process of manufacturing? Is there a process of burning it and then putting it upon the market?

Dr. JENKINS. I do not think it is a process of manufacture, because there is nothing gained by scorching good wheat.

Mr. HOYT. I would like to ask if you do not come across samples of what is called "Boston Mixed Feed?"

Dr. JENKINS. Oh, yes. The Boston Mixed Feed is simply a mixed wheat feed. It is simply a name for it. It is not a Boston product, but it comes on from the mills and is fed all over the country. It's a genuine wheat feed. There are a large number of small flouring mills all over the country, and their product is taken up by these wholesale commission men like Cox and others. They buy the feed in the West and then it is delivered to the buyer from Western points. They never see it at all, but it is sold as Boston mixed feed.

A MEMBER. I would like to ask the doctor in regard to the analysis of wheat bran. He says that spring wheat bran contains a little more protein than winter wheat. That, as I understand it, is the digestible part?

Dr. JENKINS. Those figures are for crude protein. I assume that the protein of spring wheat bran is as digestible as that of winter wheat, but on that, of course, our analysis gives us no information. That is simply the total amount of protein in the bran.

The same MEMBER. There is a sentiment in our place that feeds are adulterated with plaster of paris.

Dr. JENKINS. Certainly none of the samples which we have analyzed, and we have examined, I should think, fifty or sixty, have contained any adulteration of that sort. In mixed feeds you will sometimes find a floury substance. I never saw any adulterated with mineral matter. With all feeds, though, that may be practiced sometimes.

Mr. HOYT. This fine flour is white and nice, but I like the dark the best. I know our man that takes care of the hogs says that they won't eat it. He says it makes them sick, etc. He thought it had plaster of paris in it. He always says "buy the dark." I find the dark is always the sweetest, and gives the best results.

Secretary GOLD. Is it not a simple matter, doctor, for a farmer to apply this test to any article that it is suspected has plaster in it — just burn it? The plaster will remain as an ash if there is any considerable amount of adulteration, and the farmer has an opportunity to detect it right there. I doubt very much whether there is any considerable adulteration of that sort. I have tried some of these rather heavy feeds in that kind of a way and find there is no ash left. That showed that there was no adulteration with plaster.

Dr. JENKINS. That would be a right method for detecting it if it was present in any considerable quantity as you say.

Mr. HOYT. If you put some of the bran in water, will the plaster not settle to the bottom?

Dr. JENKINS. That is likely to be a good test, yet it may be held up by the bran, or it may be so intimately mixed with the bran that you will not surely detect it in that way.

A MEMBER. I would like to ask the doctor about the protein in spring wheat bran. We can usually get spring wheat bran the cheapest. Would you advise spring wheat bran rather than winter wheat bran?

Dr. JENKINS. If the spring wheat bran always contained more protein than the winter wheat bran, and, assuming it is equally digestible, I know of no reason why that would not be more economical. But you will find some grades of winter bran that are richer in protein than certain grades of spring wheat. The products of different mills differ a good deal, that is, figuring the thing from year to year. Some large concerns put out two grades of both winter and spring bran, one richer than the other. There is quite a difference, sometimes, in whether it is No. 1 or No. 2. If you have two samples of bran before you, equally coarse, and one of winter and the other of spring, and selling for the same price, and you find the spring wheat shows on analysis to be richer in protein, I should say that would be the more economical. But, as a matter of fact, in the market you cannot tell. Even with a

guaranty which a dealer will furnish you you cannot be sure of that without an analysis of that particular lot.

Same MEMBER. I think you stated that the spring wheat contained more, as a rule.

Dr. JENKINS. Yes, a little more; a fraction of a per cent.

Same MEMBER. We have considered, as a rule, that the winter wheat was rather the better bran. If that is wrong, I want to know it.

Dr. JENKINS. You may be wrong and may be not. I give you the results of chemical analysis. But the cow herself is the only judge. Chemical data are only a guide and help in your farm practice. It may be that you will find that winter wheat bran is better relished and keeps the cows in better condition than spring bran, although it contains a little less protein. If so, use it. Chemical analysis alone cannot certainly show the physiological effects of these different feeds. The analysis only gives general indications. Between two feeds of the same general character and nearly the same composition chemical examination cannot certainly decide which is the best for feeding. Those are points for the practical feeder to determine as best he can, and to his own satisfaction. I do not believe, however, that a number of feeders would be unanimous in their decision.

The PRESIDENT. I think Dr. Jenkins has hit the point exactly on that. My own observation has taught me that it is one of those things that the farmers have got to learn to use their own judgment upon, and be guided by their own observation and experience. When you try a thing practically you know something about it which is of value.

A MEMBER. I would like to ask the doctor if he has ever taken the average prices of cattle feeds and made a computation as to the average cost of protein by the net weight?

Dr. JENKINS. Yes, we did that a number of years ago. It is really impossible to make a schedule of valuation for commercial feeds which would be in the least reliable. The fact is, that the selling price of our feeds bears absolutely no rela-

tion whatever to their practical feeding value. Cotton seed meal contains 45 per cent. of protein, and last spring you could buy it for $22.50 per ton. That is only perhaps three or four dollars more than you would have to pay for hominy chop, and that has only 12 per cent. of protein. Cotton seed meal has nearly four times as much. The selling price of these feeds has absolutely no relation to their feeding value.

Secretary GOLD. There are some other considerations which have not been referred to. For instance, the effect of the cotton seed meal, compared with linseed, upon the butter produced from the milk; the effect upon the health of the animal, and other considerations. It would not do to use all these feeds, especially in any considerable quantities, upon young animals. It might have a great effect upon their growth. Some of these professed feeds that they claim will do wonders are not worth much attention. About the only good thing that they put in is some linseed.

QUESTION. When this law goes into effect, if it has not already, in buying wheat bran, will each bag have an announcement on the bag, or will the announcement be made on a carload or a car lot by sample? Will you know the exact analysis?

Dr. JENKINS. You will know it approximately. It would be impossible to analyze every car lot that is sent out. You will know approximately the percentage of crude protein. Where it is sold in a car lot, an arrangement is to be made so that the tags will be sent with the car lot, which can be used when it is bagged. The feed dealers are endeavoring to comply with the law. It is not a thing which can be done at once. The commission merchants have got to see that that law is complied with. When the law is fully in effect every bag should have the analysis on it.

Secretary GOLD. This question of scorched wheat is one thing that I have been curious about for the last ten years. There is once in a while a mill or an elevator burnt, but the supply of scorched wheat is regular on the market. It never

has been thrown upon the market in quantities sufficient to break it. It can be had at low prices, and, as Professor Gulley said, it always appears to have been inferior wheat to begin with. I never saw a sample of good wheat among a stock of scorched wheat. I have a great many samples sent me, in the course of a year, of these products. It is usually inferior wheat. The kernels are not sound kernels. The poultry will eat the whole, but leave the black kernels to the last. The effect of these foods, and also the effect of cotton seed meal fed in large as well as small quantities to stock, and its effect upon the butter product, and the quality of the butter, are all very interesting questions to farmers. They need to be studied and understood. Cotton seed meal fed with the ration gives you a firmer butter; one that is harder and more satisfactory in the market. You substitute linseed meal for it and you get a softer product. Your butter will not answer the demands of your customers. You feed cotton seed meal in any considerable quantities and there is all sorts of trouble in your dairy from caked bags and various other troubles. You feed linseed meal and you are comparatively free from that class of troubles.

QUESTION. What is "in a considerable quantity?"

Secretary GOLD. A peck of cotton seed meal would be a pretty large feed to start with, but an old ox brought up to it gradually would use a peck of cotton seed to advantage. It would show remarkable results, and it is a saving to use it, I think.

Mr. HOYT. If you gave two quarts to a cow, would it hurt her?

Secretary GOLD. I should not expect it would, beginning with a pint a day. It is the most dangerous feed to change suddenly of any that we have. If you feed it very gradually, I think it may be fed safely.

Mr. HOYT. There is a great quantity of nitrogen in it?

Prof. PHELPS. One phase of the feed question, it seems to

me, is that we find upon the market so-called mixed feeds called standard dairy feeds. It seems to be an effort to get rid of some of these cheaper by-products of little value by mixing them up with the better grade of products, and one of the concerns manufacturing oatmeal is sending out this class of product. You will find by examination that it contains a proportion of oat hulls. There is also in it a certain proportion of corn meal. We find some cotton seed and some wheat feed. It is put out under a guarantee, and further than that I am told that the company offers a reward of $100 if anybody will find a sample of that feed upon the market which contains less protein food than they guarantee. All that is very good, so far as it goes, but it does not tell the whole story. There is another side to the question besides the chemical side, and that is the digestibility of it. And then there is another question, whether that mixed feed can be bought cheaper than we could buy certain standard ingredients and mix them ourselves? And if we did that, whether we would not get as good if not a better article? I was driving one day about ten miles from the college, and a party stopped me and wanted to know what I thought of such and such a feed. I told him on general principles I did not think much of mixed feeds. I told him that I did not take much stock in mixed fertilizers or mixed feed, and I asked, "What is the nature of this feed?" He went on and told me that the company guaranteed 18 per cent. of protein and 4½ per cent. of fat. I said "I wonder if you could not mix up that feed from standard ingredients and get it cheaper, and at the same time have a better feed than that will give you?" He says, "I don't know. This cost me $22 in my market." I said "You give me a sample of it and I will look it over. I will try to figure out a mixed feed from standard materials that will have as good an effect, and at a better price." I took the sample home and ran it through a sieve, and I got out 33 per cent. of material which was almost entirely oat hulls. I looked over the rest, and I could detect

cotton seed meal and corn meal, and some wheat feed. Then I went to work and figured out the total protein in the following mixture: 200 pounds of wheat bran, 200 pounds of wheat middlings, and 100 pounds of cotton seed meal. I found it would contain 20 per cent. of protein, and 4.8 per cent. of fat, which was some better than that the company had guaranteed. But that does not tell the whole story. I wanted to see how much the difference of these two mixtures would be on a digestibility basis. I took the best that I could find from materials of a similar nature, and found on figuring it out that this feed had about 14½ per cent. of digestible protein in it, and something like 3.8 per cent. of digestible fat, while the other mixture which I suggested to the man had 17½ per cent. of digestible protein and 4½ per cent. of fat. The mixture which I suggested to him, according to the ruling prices in his nearby market, could be bought for $21. The mixture that was offered for sale, that is, his dairy feed, could be bought for $22. The mixture which I suggested to him had 3 per cent. more of protein and a little more of fat than this dairy mixture which would cost him a dollar more in the market. He saw the point right off when I wrote him at length about it. A short time afterwards I saw his wife and asked her if he got my letter, and she said, "Yes, he got the letter, and he don't say so much about this mixed dairy feed as he did before you wrote him."

Prof. S. W. Johnson. In regard to scorched wheat, there may be two possible explanations. One is: wheat which has been damaged somewhat in the harvesting and has sprouted, or has shrunken, and has been scorched in drying, and the other is burnt wheat. If that be the fact, then the question as to this constant supply is easily explained. Years ago there was a noted scholar in Brussels, Belgium, by the name of Keplar, and he was the first man in this world to make a long and thorough study of statistics. It has not been many years that the world has had statistics so extensive, so accurate, and

carried on for so long a time as to enable an investigator to draw a satisfactory conclusion. He found that taking the statistics of Belgium, which had been carried on for a good many years, that once in so often there was a murder; once in so often there was a burglary; and once in so often there was this, that, and the other of these crimes. They were proven by this investigation to occur with regularity. Now in this way these fires that injure elevators, and the vast number of bushels of grain that they contain, occur in the Western wheat-growing countries. If we had the statistics of them we could probably tell when there would be another fire, and how many bushels would be spoiled every day or every week. It is the inevitable recurrence of fires which we put upon record as accidents which explains, in my opinion, how this constant supply of scorched wheat is kept up. If we had the statistics we should find there were a certain number, and that they occurred with something like fixed regularity.

Mrs. R. W. Stimson. I do not know whether it is time for another explosion or not, but only a year ago last April a great elevator in Boston exploded, and they said that the elevator contained at the time 350,000 bushels of wheat. That is quite a quantity and would last for some time.

Mr. Hoyt. I would like to inquire if burnt wheat is any better?

Secretary Gold. There is no reason why it should be. Scorching may destroy the germs of decay and prevent further damage. This discussion and the presentation of subjects by the State Experiment Station professors will be continued this afternoon at 2 o'clock.

[Convention adjourned to 2 P. M.]

AFTERNOON SESSION.

Friday, Dec. 15, 1899.

Convention called to order at 2 P. M., Vice-President Edwin G. Seeley in the Chair.

The PRESIDENT. Now I know there are a good many questions which some of you wanted to ask when we adjourned this morning. Now there are those here who are competent to answer almost any question you may ask. There is Dr. Atwater over there. He is a first-rate man to ask questions of. Now if there are any questions suggested by Dr. Jenkins' address this morning, you are at liberty to ask them.

Prof. PHELPS. There was something that I had thought of in regard to the digestibility of protein. We are learning, for instance, all about fertilization, and taking nitrate of soda as a basis to work from and figuring down from that to the solubility of nitrogen; taking that as a standard of solubility, and then going into the line of feeds and working on the same basis, and finding out the digestibility of protein that is found in different feed-stuffs, and arriving at a conclusion as to what is best for animals the same as we have in fertilizers as to what is best for plant life or plant food. Of course I am not familiar with the line of work that is in progress, but I should think that would be one of the things that would be developed, and it certainly is quite essential.

Dr. ATWATER. If I understand the gentleman's question, it is whether experiments are being made to get the measure of digestibility of protein and the fat, carbo-hydrate, in different feeding stuffs like hay, bran, corn meal, etc.?

Prof. PHELPS. It is not the question as to how much there is there, but how much can be appropriated?

Dr. ATWATER. How much can be digested? If you had a dollar for each experiment of that kind that has been made with domestic animals, not only with cows and sheep, but with horses and oxen and swine, and other animals, I was going to say that you would not have to worry any more. There are thousands of them. A great many have been made in this country, and a good many at the Storrs Station. If you will take the pains to look in the Storrs Station reports you will see the figures which give the results of those experiments,

and gives them boiled down from data. Now, at the same time, while that ground has been gone over many times, that question is a more complex one than you think. Lots of these things which seem simple at first are rather hard to learn. Suppose you have a given kind of bran, and you feed that with some other feeding stuff to sheep and cows. You will perhaps be a little surprised to know that the difference in the amount, or in the percentage of the amount, of protein that will be digested by cows or sheep is very small. The percentages are very nearly the same. You will also find that the percentage digested from different feeding stuffs will run from less than 50 per cent., and often lower in straw, up to 90 per cent. and more in some of the meals. And in the coarser hays, 50 or 60 per cent., and in the finer hays, where the grass was cut when it was young, to maybe 70 per cent. or more. In nice fresh grass and that sort of thing, why, it is almost all there. Does that come anywhere near answering your question?

Prof. PHELPS. My idea was to know whether there had been experiments made or whether that was something that had to come.

Dr. ATWATER. Oh, yes, the number of experiments which have been made is very great. Now I do not suppose you want to listen to a long discourse on this subject at this time, because there is something else on the program, but it is not simply how much the animal will digest and utilize, but also how much it will cost. A leading German has thought that the food-digestible materials from straw, for instance, cost pretty nearly as much as the material was worth. I should not want to have that quoted as an exact scientific statement, but it was something like it. On the other hand, it costs very little to digest material from corn meal, and not a very great deal from cotton seed meal.

The PRESIDENT. If there are no other questions to ask Dr. Atwater, I think Professors Britton and Sturgis have something here that they are ready to tell us.

THE SAN JOSE SCALE.

Prof. W. E. Britton.

Mr. Chairman, Ladies and Gentlemen: In connection with the various kinds of work which we try to carry on at the Experiment Station the subject of insects has been given some attention. As you all know, there has been a great deal said and written about the San Jose scale. It has caused more trouble, and more attention has been given it, perhaps, than any other insect that we know about. Some of our California friends have accused us of being alarmists; they state that we have gone to the extreme, and have talked and written so much about the scale that it has unnecessarily scared the Europeans, who have therefore prohibited our products from being brought in there because they feared that the scale would be introduced upon them. The scale was first discovered in Connecticut by Dr. Sturgis, in June, 1895, near New London. I have a chart here which shows the territory of the State with the counties designated, and the red dots show the places where the San Jose scale has been discovered. At this locality where it was first discovered it had been brought into the State upon nursery stock from New Jersey. The stock was set out in 1891, and the scale had developed thereon for four years before it was discovered in 1895, and at that time a great many of the trees were dead from its effects, and others seriously injured. Very shortly after this the scale was discovered in Hartford, New Haven, and several other places. As a means of finding out where the scale existed in the State it was ascertained where this stock was purchased, and the nurseryman requested to furnish a list of all his Connecticut customers. A circular was then sent to each customer, telling them about the scale, its introduction into the State, and asking them to carefully examine their stock and to report the conditions found. I think over ninety of these circulars were sent out, and about forty replies were received, of which twenty-eight reported that they could find no indications of the scale, while several reported that they found it, and others that they did not know whether they had it or not. In regard to the scale I will say that it is supposed to have been brought into the

country about 1870. At first it was thought the scale was brought here from Chili, in South America, but further investigations tended to show that although it had been brought here from Chili it had previously been taken to Chili from our Western coast. At present we are not sure about the original home of the San Jose scale. It may have been California; it may have been Japan. At present it is being shipped into this country on nursery stock from Japan. We know that it occurs there, and, of course, it may have been taken there from this country, but the probability is that Japan is its original home. The scale was first described by Comstock in 1880, who saw it originally upon trees in California. He stated that he believed it was the most pernicious insect he had ever seen. In 1893 it was discovered in Charlottesburg, Va., and this was the first indication that we had of its having been brought into the Eastern states. Shortly after that it was found in Delaware, Indiana, Maryland, Pennsylvania, New York, New Jersey, and Connecticut, until now it is probably safe to say that nearly all of the Eastern and Western states are infested with this insect, the extreme Northern states, perhaps, being the only ones that can be said to have escaped, and we do not know that to be a fact. The life history of this insect here is very different from what it is in California. Comstock described the egg of the insect, but the entomologists of the Eastern states say that they have not seen the egg stage, and we do not believe that it has an egg stage here. It appears that in California there are three broods each season. Here the number of broods has not been determined. Probably it depends largely upon the climate, the locality, and upon the season. When this scale was first discovered in Connecticut we told the farmers and others that it was a very easy matter to identify this insect; that it was circular in form, very small, never having a diameter of over an eighth of an inch, and even as small as one-thirty-second and from that to one-sixteenth of an inch in diameter when found upon the bark of trees; that it was of slightly different shape from the greater portion of scale insects. At that time what we told the farmers was true. It was very easy to identify this from the other scale insects which were known to exist in Connecticut. At present, however, it is quite different, and it is a much more difficult matter to identify this scale. Why? Because several other species

have been brought into the State, and a still greater number have been found in neighboring states which belong to the same genus, and are so similar to the San Jose scale that no one except a specialist on scale insects can identify these or tell one from the other. In fact, they almost run together. There are also great variations in such species, so that they are identified and kept distinct with a great deal of difficulty. So far as the nurserymen and orchardists are concerned, however, this need not be attempted, as it is only a question whether you have one species or the other, and that can only be determined by a specialist, and he has got to study them carefully under a microscope to tell them apart. So far as injurious effects upon trees are concerned, there is probably not much difference between the San Jose scale and several other species. We have a species which was described five years ago in Illinois, which is known to entomologists as *Aspidiotus Forbesi*, Johns., and which has been given the common name of the cherry scale. It is very similar to the San Jose, and so far as I can learn it is about as serious in certain localities in Illinois as the San Jose scale has been. There has also been recently introduced into New York State a European species, *A. ostreæformis*, Curtis, which is likely to be quite as bad a pest here as the San Jose scale. There is a great similarity between them. We have from Japan at least two varieties. They are considered by some students of insects to be merely varieties of the San Jose scale, while others call them different species. They are being brought in on nursery stock every year.

Now since the scale was first found in the State we have tried to keep account of the distribution of it, and this chart shows the number of places where it has been found. I have not marked any names of places for various reasons. The dots simply indicate the places where the scale has been found, but you, of course, can recognize this as being the city of New Haven, and Hartford is up here. Six different localities in New Haven have been found infested, and four in Hartford. In all, it has been found in thirty-four separate localities in this State, these being, as you will notice, principally along the coast, and along the line of the New York, New Haven and Hartford Railroad as far north as Hartford. I have no doubt that it exists in Litchfield, Tolland, and Windham counties, but we have not found it there. Very likely, however, there is

more of it through the center of the State, that being the portion where the larger fruit orchards exist, and perhaps more nursery stock is handled along the line of the railroad. It is safe to say that the State is very thoroughly infested with the insect.

A great many states have legislated against this scale. Laws have been enacted to prevent its introduction. Nearly half of the states of the Union now have some form of legislation against this insect. None of the New England states have laws. Some of the states have inspection laws which provide that the stock in various nurseries shall be inspected, and that a certificate stating that no scale has been found shall be attached to every package or box when shipped. The workings of these various laws have not been entirely satisfactory. You will at once see how difficult it is to properly inspect the stock in a large nursery. Of course, if a large area of nursery stock was badly infested the inspector would find it at once. In other words, if there was much of the scale present it would be found, but if there were but very few specimens on one or two trees they might easily escape detection. It would be impossible to examine the stock so thoroughly as to find all of these individuals, because they are so small. These laws have, to a large extent, prevented the spread of the insect, and for that reason have done considerable good. As there is no law on this subject in Connecticut, our nurserymen find it hard to ship into other states without having something to show that their stock was not infested. For this reason we made an attempt, where no scale was found, to give certificates enabling our nurserymen to ship into the other states. I think we have, up to the present time, made something like twenty-five inspections in the State for that purpose. In some nurseries the scale has been found. In others it has not. We have endeavored to give the best information that we could to those men, and, so far as I know, they have tried to clean out the scale from their nurseries.

In regard to the treatment of infested stock, perhaps the best thing to be done where orchards are infested is to spray with kerosene and water. These substances will not mix, ordinarily, but they can be mixed under pressure, and several pumps for this purpose are now on the market. Each pump has an index which can be set for any proportion desired.

Where twenty per cent. of kerosene is mixed with water, the scale has been killed and no disastrous effect to the trees has followed the use of it. Nursery stock and orchard trees are not injured to any appreciable extent. Two good sprayings of this kind, preferably done when the trees are dormant at this season of the year, one done now and another a little later, will usually kill about all the scale on the tree if the mixture comes in contact with them. It is difficult, sometimes, to get it in contact with every individual scale, so we do not get rid of them all. For infested nursery stock, however, a great many nurserymen are fumigating. The stock is tied up in bundles and placed inside of a tight house, and hydrocyanic acid gas is generated. This is usually done by taking 25 grams, which is little less than an ounce, of potassium cyanide, and taking $1\frac{1}{4}$ ounces of sulphuric acid and $1\frac{7}{8}$ ounces of water. The acid is poured leisurely into the water, having everything all arranged, the house all tight and closed up except the door where the operator is to escape. Then the potassium cyanide is dropped into the liquid and the door closed at once. The operator, of course, should be very careful to get out of the way and not breathe any of the gas, for it is a deadly poison. The stock is left in this way for half an hour, and then the doors are opened from the outside and the building is allowed to become thoroughly aired before anyone enters. This is recommended as one of the best treatments for nursery stock, but it cannot be applied very successfully in an orchard. It would be necessary there to have a large tent to cover the tree. As a rule a tent is not as tight as a well-built house, and it is always hard to manage, so it seems preferable to apply the spraying treatment in an orchard rather than this gas treatment. Whale oil soap is also a good remedy against the scale. If applied when the trees are dormant, two pounds of soap to one gallon of water will kill nearly all the scales if the application is thorough.

There are certain precautions, however, that ought to be observed by an orchardist or nurseryman in fighting any of these scale insects. We are quite inclined to blame the nurserymen for all these things. Because the scale has been brought to us upon nursery stock we think the nurseryman has been careless, and does not care about these matters. As a matter of fact, no nurseryman wants to send out infested stock. It

is usually brought into his nursery accidentally, and in all cases, so far as I know, the nurseryman makes a vigorous attempt to clean it out as soon as he knows of its existence in his nursery, but I find a great many of the fruit growers and farmers will buy a tree and plant it, and never do anything else with it. In such a case if it has any scale on it at all it will develop, and soon cover the tree, and, perhaps, kill it, or, perhaps, spread to a lot of others. I think it is a very good idea for the orchardist before planting his trees to give them some treatment. Not only look them over thoroughly, but apply some insecticide. He can dip them in whale-oil soap and water before putting them out, or he can tie them up in bundles and give them the gas treatment, but the trees should first be pruned thoroughly. Have a large tank and dip them in the soap and water all except the roots. I consider this a very wise precaution, and would recommend it to everyone who intends to plant orchard trees. He must do his duty as well as the nurseryman.

In regard to legislation against this scale, it does not accomplish the desired end in fighting insect or plant diseases of any kind, but it does some good in regard to inspection. Inspection is always a good thing. The more inspection you can have the more chance you have of controlling the scale and keeping the stock free. Too implicit faith has been put in certificates sent out with stock, and we are having scale brought into this State every season, and, perhaps, every week or every day of the shipping season, which bears a certificate, and which is infested with this, or with one or the other of the closely related scales. Therefore, it seems that where there is no legislation on the subject, there ought to be some provision whereby seriously infected stock could be examined, even if it did bear the certificate of some well-known entomologist that no scale was found upon it. The certificate is an indication, of course, that the scale is not present in great quantities, but it is no guaranty that it is wholly absent. In some states, instead of having these inspection laws, they have a law making it a misdemeanor to sell any infested stock, and punishable with a heavy fine.

We have in this country quite a number, in fact, some of our most eminent entomologists, who do not believe in any legislation in the fighting of injurious insects. This has been

termed the "let-them-alone method" of dealing with insects. On the other hand, the state of California has, for many years, spent a great deal of money by posting inspectors at its ports, and a great many injurious insects have been kept out of this country simply by the enforcement of California's laws preventing the importation of infested stock. It costs a great deal of money, of course. All these things do. So that the best we can advise at the present time is that if a man finds one of these scales on his own premises, or if he finds it in his own locality, he should take every measure possible to get rid of it. We do not think it is best in this country to establish the system of inspecting everything that is brought in here. That is not to be recommended at present. Whether this State will ever see fit to enact any laws regarding the matter is a thing to be considered. As it is now, Connecticut may be a dumping-ground for all sorts of nursery stock from all the states. Many of them have laws which prohibit us from sending any stock there without a certificate, and yet they can send anything in here, infested or uninfested, and whether it has a certificate or not. But that is not a question for the Experiment Station to decide. It is a question which the orchardist and fruit-growers of the State must settle.

The PRESIDENT. I should like to ask Prof. Britton if he thinks there is any immediate danger of our being overrun with this insect pest?

Prof. BRITTON. I am glad to say that the insect does not increase as rapidly here as it does in Maryland and some of the states further south. That it does increase quite rapidly, however, is shown by the fact that in four years, peach trees, which are rapid growers, and, perhaps, $4\frac{1}{2}$ inches in diameter, have been absolutely killed. Certain winters kill a great many of these insects. I do not think there is any trouble in holding the insect in check if we know where it is, but it is so inconspicuous on trees that the ordinary farmer and a great many of the fruit growers fail to observe it until it has seriously impaired the vitality of the trees.

QUESTION. Where shall we look for it?

Prof. BRITTON. On the bark of the trunk and branches, especially around where the head of the tree is formed. It gets on the new wood as soon as it can; but, of course, on a rapidly-growing tree it does not have time to reach the tops of the new growth. I have seen bark cut from a tree with these scales two or three deep.

The PRESIDENT. Is there any other insect which preys upon or kills this scale?

Prof. BRITTON. There are a great many which prey upon the scale. Various species of lady beetles do. Ichneumon flies of various kinds are persistent enemies of this scale. Out in California, where it was formerly so serious, it is doing little damage now. That may be the case here. At the present time I should be inclined to be quite as much alarmed about these other scales which are being brought in here as I should about the San Jose scale. Some of them are very difficult to identify. The scale is here, and we can never hope to exterminate it by anything which we can do. It will remain here in the State unless its natural enemies exterminate it eventually. That has never been the case that I know of, so that most of the species of insects remain. It is gray in color; sometimes nearly black.

The PRESIDENT. I would like to ask if Connecticut is the dumping ground for all sorts of stock. Is that universally so, that they are sending in here infected nursery stock?

Prof. BRITTON. I did not mean by that to cast any reflections on the nurserymen of other states at all. It is merely a case of there being nothing to prevent it.

QUESTION. I would like to know if we in Connecticut are getting any worse stock than they are sending to other sections?

Prof. BRITTON. I would not care to make that charge. Some of the nurserymen, or those who buy stock, may be able to speak on that point. The situation in this State leaves the growers unprotected in the matter. We cannot ship stock into

other states without a certificate that it has been inspected, but they can ship it in here, and we have no legislation by which we can destroy any infected stock, or keep it out. The question lies with the buyer and the public.

Secretary GOLD. We receive here certificates of nurseries in New York that have been inspected and pronounced free from this scale. They are sent here sometimes to the Secretary of State's office, and sometimes to the Secretary of the State Board of Agriculture. I have deposited all the certificates that have come into my possession with the Secretary of State in Hartford, with a request that he preserve them. I believe that they are preserved there. There have been quite a goodly number of them within the last two years. I do not know that there is any authority or duty imposed upon any body or board to preserve them, but they are there and can be examined if wanted.

Prof. BRITTON. I would like to ask, Mr. Secretary, if any nurseryman could apply to the Secretary at Hartford and be informed about this; that is, who had registered, etc.?

Secretary GOLD. I should expect that an inquiry addressed to the office of the Secretary of State would receive a courteous reply with regard to the nurseries who had sent certificates or registered.

Prof. BRITTON. I know that several of the New York nurseries have sent us copies of their certificates. Of course those last for only one year.

The PRESIDENT. You hardly think that they are sufficient to protect the fruit growers of the State from the San Jose scale, do you, Professor?

Prof. BRITTON. No, sir; not in all cases.

Mr. IVES. I would like to ask Prof. Britton where the scale is located in and about Meriden? Is it in the town of Meriden, or in the adjoining towns, or about this section?

Prof. BRITTON. I think there is some present in Meriden.

I do not know just what measures have been taken to get rid of it. It has been reported from Meriden.

Mr. IVES. You do not give us any names.

Prof. BRITTON. I should prefer not to do that. It is bad enough to find the scale on one's trees, and it is generally found out by accident. If it remains there, why, it is the fault of the man who owns the trees.

Mr. IVES. If it is found on one tree, is it not likely to get to another one?

Prof. BRITTON. It is quite likely to; yes, sir. When the young scales are born they move about for a few hours, perhaps for a day, before they decide on their location, and then become fixed to the bark. They crawl about, and spread on a tree in this way. There are various agencies by which the scale may spread from one tree to another. A great deal of speculation has been indulged in along that line. Some think that the leaves in blowing about carry the scales, and others state that they may be carried by insects or by birds. We know that they do spread from tree to tree.

A MEMBER. I should suppose if anyone contemplated purchasing fruit trees from any nursery outside of the State, they could get a certificate from the nursery if they asked for it, and in that way would be able to protect themselves. I would ask Prof. Britton if that is not so?

Prof. BRITTON. It is probably true. One reason why these men send certificates into this State is because the New York law requires it. It says that they shall place on file copies of the certificates. I think they are obliged to send them to every state in the Union. Of course where there is any state entomologist they are all filed in his office, but there being no such officer in Connecticut, I suppose they do not know where to send their copies of the certificates to be placed on file.

Mr. HOYT. Mr. Chairman, I think these certificates are about as big a humbug as anything connected with the whole

business. You cannot send a box of trees out of New York state unless it has a certificate tacked on the head of it. But does that protect the one that buys the trees? Not a particle. We may pass all the laws we choose to here in Connecticut to regulate that thing, and we cannot stop it. An inspector may go over a nursery, and not find the San Jose scale, and give a certificate that it is free from the insect, and yet there may be some trees in that nursery that the inspector has not seen. That is very likely, for we cannot examine them all. No inspector can go into a nursery and look it over in a year and say positively that no tree in it has this pest. Probably out of millions of trees that would have to be looked over there might be three or four that might have it, and the rest be all right, yet that small number would be enough to infest that nursery in time. There is no trouble about your certificate. You can get that all right, but it does not protect you absolutely. No nurseryman will be foolish enough to cultivate the San Jose scale upon his trees, or any other insect, if he knows they are there. It is as much for his interest to destroy those insects as it is for his country that they should be destroyed. There are many things which are more dangerous to a tree than the San Jose scale. You take the roots of a tree, a thing which we hear very little about, and a thing which is never inspected, and there is an insect that bores right into the roots, and causes little knots to come up on them, and in time the roots will be so full of those that the tree will be destroyed. We hear nothing about this insect that is working at the roots. The San Jose scale, or any insect, in my opinion, upon the body of a tree we can exterminate if we attend to it. Any person who sets out fruit trees should expect to take care of them, and should do it just the same as he would care for his chickens or his children. Setting out a tree, and then neglecting it, is something which should not be indulged in. To take care of a tree is a matter of profit. Every young tree which is set out should be washed with potash water of the strength of

one pound of potash to two gallons of water. It will clean the tree of all foreign substances, and make it bright and clean and lively. I have not tried it on the San Jose scale, but that is an animal we do not cultivate. I will not swear that it is not there, either. The oyster-shell scale you can clean off with potash water. Every young fruit tree should be washed with that in the spring. It helps the trees wonderfully, not only in cleaning away all foreign substances, but it helps the trees in health. The potash water soaks down into the ground, and it's a good fertilizer of itself. It is not very expensive, and if you will take a little time and wash your trees in this way you will find that it will pay you. It will clean out these bark insects.

Mr. N. S. PLATT. There is one good mission that a certificate accomplishes, even if it is put there by law, and that is, it will carry some information along with it, so far as the box with the certificate on it is concerned, to the man who purchased the trees, or to the man who plants them, so that he, perhaps, will keep his eyes open and watch for any species of scale that appears on the trees. That is one good thing that the certificate accomplishes, even if it is put on by law. I do not see as it does any hurt. Outside of that I agree with Mr. Hoyt that it is not in the power of any inspector to certainly say that there is no San Jose scale on nursery stock. They do not pretend to say that. They only say that they do not find it. It is a great job to properly inspect nursery stock, but it is necessary to do it. Probably if the scale was at all conspicuous the inspectors would find it readily.

Now, I want to mention one thing about the remedy for this scale when it is on a tree. Some of the people down in one part of New Haven County have been accustomed to spraying their fruit trees, even the large ones, in winter, with sulphate of copper and water, and using it much stronger than I have been taught to use it whenever I did use it. That is, they put on about one pound of copper to ten of water, and

sprayed it right on to their apple trees. One gentleman had some Japanese plum trees with the San Jose scale, and he says that spraying of this kind, put on in the winter, has about exterminated the scale. I think there is no danger of hurting the tree with this strong solution of sulphate of copper, applied in winter. The proportion is one pound to ten gallons of water. It is a wonderful cleaner of old apple trees, and if it is a cleaner of San Jose scale, I should be willing to give them all the spraying the trees needed. I think I would spray them early. I understand that with any such thing as potash water, or anything of that kind, while oftentimes its action loosens the scales and weakens them, it does so without killing them. The second application may be very apt to complete what the first did not, and if you could put on two in a season it would be well.

Mr. IVES. Mr. Chairman, I would like to inquire of the last speaker if, during the summer, when the bordeaux mixture is adhering to any portion of the tree, whether it would not be impossible for the scale to implant itself on that portion which was coated with the bordeaux?

Mr. N. S. PLATT. I never had a live scale on any tree that I know of. I have not followed the thing at all. I do not believe, however, it would prevent it. Perhaps Prof. Britton can say.

Prof. BRITTON. I should expect that he would find a good many places that were not coated.

The PRESIDENT. Now, if there are no further questions on this very interesting subject, we will listen to Prof. Sturgis.

ACTION OF BACTERIA IN SOILS.

PROF. W. C. STURGIS.

Mr. Chairman, Ladies and Gentlemen: No subject of an agricultural nature has, during the last ten years, taken such a hold upon the attention of scientific men as the subject of the

source of plant-food, and particularly of the manner in which that food-supply is elaborated in the soil. The latter is brought about largely through the agency of bacteria, and, perhaps, I cannot do better than to offer some suggestions regarding the action of bacteria in the soil, and the relation of bacteria to agriculture.

It is, perhaps, quite unnecessary for me to say that bacteria are among the very smallest of organized beings that we know. They are distinctly visible only to high powers of the microscope. They exist in the form of minute spheres, of rods, bent or straight, and occasionally of spirals. They are to be found almost everywhere in air, water, and soil; the only places in which they are not found being the air on the tops of high mountains, and in mid-ocean, the air from the lungs of healthy animals, the internal fluids of such animals, and the soil in a considerable depth below the surface. The whole group of bacteria may be divided into three minor groups; first, those which grow on dead organic matter, and are known as saprophytes; secondly, those which grow upon or in the bodies of living plants, and animals, and are called parasites; thirdly, a small group, the members of which live upon inorganic matter.

Bacteria may also be divided into groups in accordance with their behavior toward oxygen, some requiring oxygen for their growth, while others thrive only in a vacuum or in an atmosphere completely deprived of oxygen.

Finally, it must be borne in mind that most bacteria grow best in an alkaline medium; an excess of acid is unfavorable to their development. Such, then, are the organisms which help to elaborate in the soil the materials which plants require for food. We may next inquire regarding the source of those materials.

Plant-food, broadly speaking, consists of the four elements, carbon, oxygen, hydrogen, and nitrogen. These four substances compose ninety-five per cent. of the food of plants. If however, we take a plant and burn it, we find a residuum of gray ash, consisting of various chemical salts. These salts were originally a part of the plant, and we find that they are compounds of potash, phosphoric acid, lime, iron, magnesia, and a number of other substances in smaller proportions. We see, then, that a plant consists not only of the four elements mentioned above, but of various other substances besides.

Now, what is the origin of the component parts of this ash? Where does the potash come from, and the lime, and the phosphoric acid? Roughly speaking, they all come originally from the soil; but after all, what does the soil come from?

If you take an ordinary bit of granite rock and analyze it, you will find that it has a very complex composition. There are, in the first place, no less than seven minerals which enter into its composition. An analysis of these seven minerals shows that they contain the following materials: silica, potash, lime, soda, magnesia, iron, and phosphoric acid. All of those things are contained in one block of granite. In winter and summer that granite rock is exposed to constantly changing atmospheric influences, which tend to disintegrate it. Water flows over it, charged with various acids, which dissolve parts of it; the roots of trees grow down to it, force their way into its cracks, and in course of time split it in pieces; frost reaches it and splits it further still, and so on through the influence of various forces and influences the process of disintegration goes on until, finally, we have got that granite block reduced to the seven minerals of which it was composed. Then the acids in the soil begin to act upon it still further, and the minerals themselves are decomposed, and we have, as the final result, what we call "soil," which consists of these various minerals and materials I have named, lime, potash, magnesia, etc., mingled with bits of the original granite not yet broken up, and helping to make the soil open and porous. Now, you will notice that the final stage in the decomposition of that granite has been through the action of organic acids held in solution by water, which, coming down upon and flowing over the rock, has been scaling it and breaking it up. These organic acids come very largely from the disintegration of vegetable matter in the soil, and this disintegration of vegetable matter is brought about mainly by the action of bacteria. So that not directly but in a very intricate manner we see that the final disintegration of the rock as a result of which the inorganic plant-food is separated out, is due, primarily, to the action of bacteria in the decomposition of vegetable matter, thereby releasing the acids which act upon the substances contained in the granite. This accounts for the presence in the plant of the substance composing its ash. But these, as has been said, comprise only about five per cent. of the weight of the plant.

Of the substances composing the remaining ninety-five per cent., viz., carbon, oxygen, hydrogen, and nitrogen, the first occurs in the air, combined with oxygen, in the form of carbonic dioxide; the hydrogen occurs in the soil, combined with oxygen, in the form of water. From the air, then, the plant obtains carbon and oxygen; from the soil it obtains hydrogen. This leaves only the nitrogen unaccounted for. Where does that come from?

Of course nitrogen exists in atmospheric air in considerable quantities, and we might think that the plants could get it directly from the air. But this they are, as a rule, unable to do. It is true that there is a class of plants, to which belong beans, peas, clovers, and plants of that character, which can indirectly take nitrogen from the air and utilize it, but it is only that class of plants, so far as we know, which can use atmospheric nitrogen at all, and even then it is done through the action of certain bacteria which live as parasites in the roots of these plants, absorb the nitrogen from the air in the soil, and pass it over to the plants for use. It is on account of this peculiar ability on the part of these so-called "leguminous" plants, to take up nitrogen directly from the air, that they are so largely used as cover-crops, or as crops to be plowed under.

But the great majority of plants must get their nitrogen from some other source than the atmosphere. Of course we can apply nitrogen to the soil artificially, but we only do that to a very limited extent. The main source of nitrogen upon which plants have to depend is the black, organic matter known as "humus," which is found in all soils in quantities varying from one to five per cent. This humus is composed of the remains of plants which have decayed and become condensed into a black, dense, fibrous mass. This mass is made up of the cells which originally went to form the tissues of the plant and of the contents of those cells. The cells themselves, or rather, their walls, are composed of a very tough, resistant substance called *cellulose*. When a plant decays this substance remains, practically unchanged, in the form of fibre, and enters largely into the composition of humus. But fibre (cellulose) contains no nitrogen, hence it may be disregarded in our consideration of humus as a source of nitrogen.

The contents of the plant-cells are chiefly organic substances, known as *carbohydrates* and *proteids*, of which the latter

alone contain nitrogen, and, therefore, have a bearing on the question in hand. Here, then, is a supply of nitrogen, but, as it exists in humus, it is in a condition not available as food for plants. Here the bacteria of the soil begin to play their part. Through the agency of putrefactive bacteria the vegetable matter in the soil decays, and the nitrogen portion of it is converted into ammonia; by the further action of bacteria this ammonia is converted into *nitrites* (compounds of nitrous acid), and finally into *nitrates* (compounds of nitric acid), in which condition the nitrogen becomes available as plant-food. This process, which is constantly going on in soils containing humus, is known as " nitrification," and the organisms which bring about these chemical changes are known as " nitrifying " bacteria. It is evident from this that a certain amount of humus in the soil is essential to the growth of plants, and, further more, that by continuous cropping without corresponding additions of humus, a soil may become so depleted of that substance as to be no longer able to support a crop, when it is said to be " burned out."

As an illustration, on a small scale, of this nitrifying process which is constantly going on on a vast scale in soils containing humus, an interesting experiment performed by Schlösing, a French investigator, may be noted.

He took a glass tube, perhaps an inch in diameter, and three feet long, and this tube he filled with a mixture of pure sand and carbonate of lime. Through this improvised filter he ran sewage, and presently he found that carbonate of ammonia was being formed, evidently by the action upon the carbonate of lime in the tube, of ammonia produced by the decay of nitrogenous matter in the sewage. This process went on for fifteen or twenty days, the quantity of ammonia produced from the sewage constantly increasing, as proved by the carbonate of ammonia in the water which came through. Then there began to appear in this water soluble nitrates, and these increased in quantity, and the amount of carbonate in the filter decreased, until it became evident that the carbonate of ammonia had been entirely transformed into nitrate. Schlösing at first supposed that this was purely a chemical process not connected in any way with living organisms. But he soon discovered that the process could be stopped by heat, or by passing a germicide through the tube, and he rightly concluded that the transforma-

tion of ammonia compounds into nitrates was brought about by living organisms. He failed to isolate these nitrifying organisms, but in 1890, a Russian investigator, named Winogradsky, succeeded, by special methods, in isolating two species of bacteria, one of which proved to be the active agent in the transformation of ammonia to nitrites, and the other the organisms which changed the nitrites to nitrates. To the combined action in the soil of these two minute organisms, the higher plants owe by far the larger part of the nitrogen which they need, and it is from the nitrogenous matter contained in humus, and set free by the action of putrefactive bacteria, that the nitrifying bacteria manufacture nitrates.

As I said in the beginning, some bacteria require oxygen, and some do not. Nitrifying bacteria are among those which do require it. Every farmer now-a-days tills his soil. He believes that the more he can practice tillage the better his soil will be, and the better crops he will get. We heard yesterday that people did not formerly do this; they did not see any use in it except to make the soil finer so that the roots of the plants could take it up. That was the idea in George Washington's time; but now we have learned by experience that the more we can till the better crops will we have. The reason for this becomes apparent in the light of what has been said above. These nitrifying bacteria must have oxygen, and they must have a big and constant supply so as to aid them in the production of nitrates. If this end is to be attained, the soil must be plowed deep and kept constantly stirred. Only by constant tillage throughout the growing season can the nitrifying bacteria be kept supplied with oxygen, and thus produce nitrates. Tillage is fertilization with nitrates.

Furthermore, these organisms are more active in late summer than they are in the spring or winter. We readily see, therefore, why we must not practice tillage in the autumn. We do not get good results if we do. The proper time for tillage is when the crops are growing in summer, and when the nitrate is needed. If we practice tillage in the late summer then we must put on a cover-crop of some kind to hold these nitrates during the autumn and winter. By tillage in late summer we have given the nitrifying bacteria an incentive to work, and they are forming nitrates as fast as they can, and

unless we hold their product in some way for next year it will escape to no purpose.

Again, moisture is absolutely necessary upon a dry soil, for without it no nitrification goes on. On the other hand an excess of water tends to prevent the action of nitrifying organisms, and then there comes into action another class of bacteria very much like these nitrifying bacteria, but which have the power of turning nitrate into nitrite, and nitrite into ammonia, and ammonia into free nitrogen. They are called denitrifying bacteria. These denitrifying organisms cannot live in the presence of oxygen. They must have absolute freedom from oxygen in order to grow. You have these two, then, the nitrifying organisms requiring oxygen, and the denitrifying organisms unable to grow in the presence of oxygen. What is the result? If the soil on which tillage is practiced constantly is of good depth, you are having nitrification going on rapidly, but let that soil be damp, or late in the fall, stand without a cover-crop to protect it, or water settle on it, and you have got it exactly into the condition where the nitrifying organisms cannot grow, and all the nitrates which the nitrifying bacteria have been storing up, are seized upon by the denitrifying bacteria, reduced to ammonia, and given off into the air.

In these facts one sees another powerful reason for underdrainage, viz., that in so doing we draw air into our soil. If the soil is full of water it is free from oxygen, and we want to draw the water out in order to let the air down through the soil, and let these nitrifying organisms have their best chance for the production of nitrate. Finally, I also said that some bacteria grow better in an alkali medium than in an acid medium. Perhaps that explains to your minds without any further words of mine why it is that on heavy muck-land, full of humus, we can sometimes apply lime with great advantage. What has been the action of bacteria on such land? They have seized hold of the vegetable matter, particularly the carbohydrates, and have changed them into organic acids. The soil has thus become sour, and the nitrifying bacteria cannot grow in it. Now, what are we going to do to remedy that state of affairs? Why, put a little strong alkali on. Put a little lime on, and let it become thoroughly mingled with the soil, and then, if possible, keep the land under-drained so as to get rid of

the water and so as to draw the air down through it, and keep tilling so as to keep it fresh and full of oxygen. The more tillage is practiced in the proper season the more we are going to have the formation of nitrates, by giving a chance to the nitrifying organisms to produce the substance which our plants need above everything else.

Mr. IVES. I would like to ask the Professor if he has followed the possibilities of liquid air in relation to agriculture?

Prof. STURGIS. No, sir. I know it is cold, and that is about all I do know about it.

Mr. STANLEY. I would like to ask what relation these bacteria have to the formation of compost? I know when I was a young man my father used to have his men spend a good deal of time in picking over the compost, and he used to draw the manure to the farm soon after it was dropped, and then in the spring it had to be turned over about so many times before it was applied to the land. There was a belief that fresh manure from the farm was no use to put on a grass plot, but that it was better as compost which had been turned over. I would like to have Dr. Sturgis give us an explanation, if he can, of the action that took place in it by having it turned over.

Prof. STURGIS. I should much rather that Prof. Johnson should answer that, as he is sitting here beside me.

The PRESIDENT. I would like to ask if tillage in the fall, without having any crop on, is injurious?

Prof. STURGIS. I should say decidedly so from my standpoint. I am not a practical farmer. I am only speaking from what I know of the action of these organisms in the soil. By fall tillage you secure a greater activity in the making of nitrate from humus, and if you do nothing in the way of a cover-crop, or in any other way to hold this nitrate there through the winter, I do not see how you are going to avoid suffering a tremendous loss of nitrate.

Secretary GOLD. Prof. Phelps, let us hear from you.

Prof. PHELPS. Prof. Sturgis has given a very good introduction to the talk that I was expecting to give a little later, and if I give it now I will be using up my thunder ahead of time.

The PRESIDENT. Thunder away. Always do it when you have a chance. Come around here where the audience can hear the thunder and see the lightning. Ladies and Gentlemen, Professor Phelps of the Connecticut College.

Prof. PHELPS. Mr. Chairman, and Members of the Board: Seeing my thunder is called for, I suppose I shall have to give it. As I said a moment ago, what Prof. Sturgis has said is a good introduction to what I had planned to present to you this afternoon, that is, as to the Value and Uses of Nitrogen as a Fertilizer. You have been told by Prof. Sturgis of the possibility of supplying your crops to a great extent with the natural or stored up nitrogen contained in the soil, and you have been told, also, of the possibility of supplying much of this nitrogen through the growth and cultivation of certain crops, yet, if we take into consideration all of these natural sources of nitrogen, there is not enough for all the needs of our crops. We find that the supply of nitrogen in nature is being used up constantly. All of our cereal crops, which are grown to such a vast extent in the west, are taking away from the soil large quantities of nitrogen. We are bringing that nitrogen here to the east, and are throwing it into the ocean through the sewage of our cities. It ought to go back upon the land, but only a small portion of it does go back through the supply of fertilizing material that is obtained from fish. Prof. Sturgis has told us how the supply of this natural nitrogen is constantly being wasted. He has touched upon a very practical question, and one that we need to study a great deal more carefully than we have, that is, how can we conserve the natural stores of nitrogen in the soil? I believe that the question of cover-crops is a very important and vital one. I believe, to-day, wherever we see farm lands exposed, without any crop upon them from the month of August to the month of December, and often bare of snow during the winter,

there are large quantities of nitrogen being carried into the drainage that are almost entirely lost to our crops. Let us take a look at nature in regard to the question of cover-crops. If you leave a field in a state of nature any considerable length of time it will soon become covered with a crop of some kind. There will be a crop of weeds or of grasses. There seems to be an effort on the part of nature to keep crops upon the soil just as much of the time as possible. It seems to me the explanation of this is that there is going to be a loss unless a plant is there ready to utilize the food materials as they are made available. Now, I would not be understood as advocating that farmers allow weeds to grow among their crops, or after the crops are harvested, but I would advocate that the fields be not left bare during the fall and winter months.

QUESTION. You mean to teach that a farmer better sow grain or plant turnips, and so have these available to take up the supply of nitrogen late in the season?

Prof. PHELPS. Yes, we need to keep our soils occupied just as much of the year as we possibly can. I believe that we need to study into the question of the conservation of the nitrogen of the soil, so as to prevent its being wasted. I think it can be done to a great extent by growing crops late in the season. I mean crops that will occupy the land after the main crops are harvested. It is not necessary to harvest them if we do not wish; they may be grown simply to plow under. The great question is what is the best crop for the purpose? A few years ago it was advocated that crimson clover could be used as a nitrogen conserver, and that it could be grown between the times of the main crops from one year to another. Several trials soon convinced us that scarlet clover is not sufficiently hardy. I think there are some of the leguminous crops which may be grown in that way. I am trying Alsike clover, and I think that this crop may be one that will prove decidedly advantageous for this purpose in our climate.

Mr. PLATTS. Will it get high enough to amount to anything? If you do not use it the next year does it amount to anything?

Prof. PHELPS. I sowed it this year in August, sowing quite thickly, and at the present time the land is well covered. The Alsike clover is even more hardy than the common red clover; it makes a thicker and more mat-like growth, and will

start up in the spring fully as early as any of the clovers. The amount of growth will not be very large, but I believe it will be large enough so that this cover will be of considerable value as a direct means of manuring the next year's crop. And, more important than that, it has served on hill land to keep the soil from being badly washed, while, if no crop had been there, the soil would have washed away to a very large extent.

Mr. TUFTS. They have been telling us all the time, "you must keep your ground clean."

Prof. PHELPS. It is a great mistake. You should have something growing upon the soil practically all the time, when anything will grow, so as to conserve the nitrogen which would otherwise be lost. I said a few minutes ago, even if we take into consideration all these natural sources of nitrogen, they are not sufficient to supply the full needs of our farms. We must depend somewhat upon other sources of nitrogen. There are three principal sources. We speak of nitrate as a source of nitrogen; this comes mainly from nitrate of soda which is found in South America. We speak of sulphate of ammonia; that is a by-product of gas manufacture; and, finally, there are the sources of nitrogen which are mainly in the shape of refuse from large slaughter houses. Now, we should utilize just as far as possible the natural stores of nitrogen in our soil, and we should utilize just as far as possible the natural supplies of fertilizing materials on the farm, but when all this is done it will be found that farm crops can be grown with better success if we supplement these by some of the commercial sources of supply. Thus the question of the uses that plants make of nitrogen becomes a very important one from a financial standpoint. It is important because the commercial supplies of nitrogen cost the farmer from three to four times as much as the commercial supplies of phosphoric acid and potash. You can buy the latter for between four and seven cents per pound, while nitrogen in the open market will cost eleven to sixteen cents. So the question from a financial point of view is important; as far as it has influence upon the yields of crops it is important; and as far as it affects the feeding of our animals it is important. We find that nitrogen, for example, is the base of one of the most important food constituents that we feed to our animals, namely, protein. All protein compounds are composed of

about sixteen per cent. nitrogen. Now, the question of the effects of nitrogen and of nitrogenous fertilizers in the growth of crops is one that has been studied for a long period of time, and we have come very generally to a uniform agreement as to what crops, or at least what class of crops, are most largely benefited as far as the yield is concerned by the use of nitrogen. We have come to the conclusion that the grasses and the cereals constitute a class of plants that stand in a relationship to nitrogen very differently than such plants as clovers, peas, and beans. While the grasses, like timothy and redtop, and the cereals, like corn, wheat, oats, and rye, respond very readily to supplies of nitrogen, clovers, beans, and peas do not. The explanation of that has, perhaps, already been given to you. It is because the latter class of plants have the power to utilize indirectly the nitrogen of the air, and hence they do not need supplies of nitrogen in fertilizers and manures to the same extent as plants that cannot get nitrogen from the air. The grasses and cereals must have nitrogen supplied to them aside from the atmosphere. Now, nitrogen may benefit this class of crops in more than one way. It has been found by experiments that we can largely increase the yields of our cereals and of the grass crop by the use of nitrogenous fertilizers, and that if we use them wisely the increase will be sufficient to make the operation an economical one, so, perhaps, I ought not to take much time on that side of the question.

But there is another side that has not been investigated in the past to a very large extent, and which the Storrs Station has lately been studying; that is, the effect of nitrogenous fertilizer upon the feeding value of the crop. We were told this morning of the importance of protein as a source of food for our live stock, and this point cannot be forced upon the attention of our farmers too strongly. We find, as Dr. Jenkins stated, that most of our crops do not supply the protein in sufficient quantities for the needs of our farm animals; that we need to supplement this supply by the purchase of highly nitrogenous feeding stuffs which contain large quantities of nitrogen. But the question comes home to us, is it not possible to do something to increase the supply of this protein in our ordinary farm crops? Along that line the Storrs Station has been working for the last six or eight years studying the effects of nitrogenous fertilizers upon the proportion of nitrogen, and in this

way upon the proportion of protein found in the crop. The results obtained have been quite surprising. We have found, for instance, in the case of corn, that the percentage of protein in the grain was increased from about ten per cent., where the crop was raised with mineral fertilizers without nitrogen except the natural supplies in the soil, up to twelve per cent. where we used at the rate of seventy-five pounds nitrogen to the acre from nitrate of soda. We have found a corresponding increase in the proportion of protein in oats from about fourteen and one-half where only mineral fertilizers were used to seventeen per cent. where seventy-five pounds of nitrogen in the form of nitrate of soda were used. But the nitrogen has also another effect. I had supposed that the effect would be mainly upon the seed, but it was found that nitrogen used in the fertilizer also increased the nitrogen in the stover. The result obtained shows that stover, where we used only mineral fertilizer, contained only about five per cent of protein, and where we used as high as seventy-five pounds of nitrogen from nitrate of soda there was seven and one-third per cent. of protein. Similar results were obtained with oat straw. The percentage was increased through the use of the nitrogenous fertilizer over and above what was found where only mineral fertilizers were used. The influence of nitrogen was even more noticeable in the case of grasses. Where we used mineral fertilizer there was only 7.8 per cent. of protein, but where we used at the rate of seventy-five pounds of nitrogen to the acre we found 9.4 per cent. of protein in the crop. That was on mixed grasses. We also made a study of pure species of grasses that were grown on a small scale in the grass garden, and we got still higher percentages of protein. For instance, with timothy, and meadow foxtail, and redtop, and one or two other grasses, the average percentage with mineral fertilizer was only 7.4 per cent. of protein, while with seventy-five pounds of nitrogen from nitrate of soda there was twelve and one-half per cent. of protein. It seems to me that this opens up a question which has been little thought of by our farmers with regard to the use of nitrogenous fertilizers. We have appreciated to some extent its value for increasing the bulk of our crops, but have we appreciated the effect of these same fertilizers in increasing the feeding value of the crop? If we are growing a crop of hay, for example, to sell, and we have two

fields, upon one of these we have fertilized heavily with rich stable manure or with some form of commercial nitrogen, and upon the other we apply nothing at all; the quality of the grass on the two fields, so far as looks is concerned, may be about the same. Suppose it is timothy and redtop in both cases. If someone comes to your barn with a view of purchasing hay, the chances are that he would be just as well pleased with that grown on the field that had not been fertilized as he would be with that which came from the field which was heavily manured with nitrogenous materials. If you could sell him that which came from the field which had not been fertilized at the same price (and there would be no difference in price unless you made it) you would better do it and retain upon your farm that which was grown upon the richest ground, because its feeding value would be greatly in excess of that which grew upon the field which had not been manured or fertilized. In like manner in growing ensilage corn I believe we can improve the quality of our ensilage to quite a degree by manuring heavily with nitrogenous materials, and thus increase the proportion of protein that will be contained in the crop.

As we increase the proportion of protein that is contained in crops produced upon the farm we ought to be able to lessen, correspondingly, the proportion of protein that we purchase from the markets. It seems to me that there are two ways in which we can increase the home supply of protein. One is by growing more crops that obtain nitrogen from the air, and the other is by liberal use of nitrogenous fertilizers upon fields occupied by plants belonging to the grass family; namely, the true grasses and the cereals. In these ways we ought to be able to reduce the amount of protein which we are now obliged to purchase in the markets.

Prof. S. W. Johnson. The paper just read by Prof. Phelps is one of great value. The comparative experiments carried on at the Storrs Station appear to demonstrate conclusively that abundant supplies of fertilizer nitrogen not only increase the yield of most crops but also increase their value as food for animals, by raising their percentage of protein.

This has, indeed, been known in a vague, general way for many years, but these laborious investigations give us, so far as

I am aware, for the first time such clear, definite, and comprehensive statements of facts as fully illuminate and emphasize a subject of vast importance. For the practical purposes of our agriculture they are virtually a new discovery.

The term "protein" which figures so considerably in discussions of the food and feeding of animals is unfortunately somewhat indefinite as now used by chemists. The most costly, and, therefore, most important ingredients of the food of men and beasts are those substances known as albuminoids, or proteids, of which the gluten of wheat, the curd of milk, the white of egg, and the fiber of lean meat are familiar examples. When we speak or hear of protein understandingly, we have in mind this class of substances which constitute a chief part of all the essential working parts of animals, and are exclusively derived from plants, where they are originally formed from the elements of air, soil, and fertilizers.

The average proportion of nitrogen in the protein of most of our forage crops is about sixteen per cent., and accordingly the amount of protein in crops can be reckoned by determining their nitrogen and multiplying its quantity by $6\frac{1}{4}$ ($16 \times 6\frac{1}{4} = 100$). Such is, in fact, the usual, indirect method which chemists employ for estimating protein. A direct estimation by separating and weighing the pure protein, is in the present state of knowledge, in most cases, impossible.

But chemists have been well aware that their estimations of protein are more or less crude and inexact, and, therefore, they formerly had the proper habit of designating the protein of their fodder-analyses as "crude protein," to intimate that it represents a mixture of real protein with more or less of a fictitious protein obtained by multiplying the nitrogen that does not belong to real protein by $6\frac{1}{4}$.

The immediate source of protein-nitrogen for most crops is chiefly nitrates. When a plant is actively growing the nitrate-nitrogen that enters its roots is rapidly converted into protein, but, under certain circumstances, nitrates remain un-

changed within the plant, and accumulate in considerable quantities in stems and foliage.

In case of half a dozen air-dry oat crops grown some years ago in pots at the New Haven Station, nitrogen was found to be present in proportions ranging from 2 to 2.7 (average 2.3) per cent., and protein accordingly would figure from 12.9 to 16.9 (average 14.3) per cent. Such amounts of protein are so large and so variable as to be quite beyond precedent or belief. Further examination showed presence of nitrates. The quantities of nitrate-nitrogen were, therefore, carefully determined, and found to range from 0.44 to 1.00 per cent. Deducting the nitrate-nitrogen from total nitrogen left amounts ranging from 1.54 to 1.82 (average 1.69) per cent. Protein reckoned from these figures would range from 9.6 to 11.4 (average 10.6) per cent.

In these six cases, therefore, the usual method of determining crude protein would have overestimated actual protein by more than one-third.

It is not likely that the percentages of protein given by Prof. Phelps are exaggerated to any such extent, if at all; but here is a possible source of error which should not be lost sight of, and is especially to be guarded against when we undertake to greatly increase the protein of our crops by copious supplies of fertilizer-nitrogen.*

Secretary GOLD. I want to have it understood by this audience that this is the Professor Johnson, Director of the Connecticut Experiment Station, who has been the leader in analyzing fertilizers in this country. This has been done in the interest of the public first through the State Agricultural Society of Connecticut, and afterwards through the State Board of Agriculture and the Experiment Station. His work will stand forever. We have another man here, director of the Storrs Experiment Station, his associate in much of this work

* For instances of the occurrence of poisonous quantities of Nitrate in fodder corn, see Kansas Experiment Station Bulletin No. 49, May, 1895.

here in Connecticut, Dr. Atwater. I am going to call upon him, and then we have got some of the younger men of the Connecticut Agricultural College that we calculate to give an opportunity to speak.

Dr. ATWATER. Mr. Chairman, I came prepared to tell you something of the work of the Storrs Experiment Station, but it is already past our regular time of adjournment, and I will not do so. I wish, however, to say a few words. I shall be glad, since I cannot state it, if you will take the pains to look over our report. I am very sorry that our last annual report has been delayed by the State printer. If any of you do not receive it, if you will simply send your address to the Storrs Agricultural Experiment Station, Storrs, Connecticut, the reports will be sent you. You will there find an account of what we are doing. Perhaps you will allow me to do a little boasting. The Storrs Station is a little place. Many of the agricultural experiment stations are larger than that. Now, the experiment stations for the country are to exhibit at the World's Fair with the co-operation of the United States Department of Agriculture, and the little Storrs Station has, I think, been invited officially to exhibit as large an area or line of its products as any station in the country. I may, perhaps, go a little further than that. You have heard of our box which we have in which we make experiments with man and experiments with sheep. And you will, no doubt, be interested to know that the Prussian government desiring to encourage the kind of investigation which we have been carrying on, and in which they have been engaged for a long time, has instructed a professor at Bonn, in Prussia, to purchase a respiratory calorimeter, which is the name we give to that apparatus I just spoke of, and the government has directed that it shall be on the model of the one we are using, and has provided the money to pay the expenses of the Professor to come here and study it, and learn how to put it up. The Austro-Hungarian government is doing something of the

same sort I am told, and they have selected a Professor to attend to it. He has already written us about it.

Now, in just a minute or two let me say that the chemical talk that Prof. Johnson has given is one with which I sympathize, but lest you might gather a wrong conclusion, which I am pretty sure Prof. Johnson does not desire, I will say that the quantities of nitrogen as ascertained in these experiments were ascertained by actual tests. In other words, here is the practical application of what Prof. Phelps has spoken of. Years ago I found on making an analysis of the quantities of nitrogen that they were less in this country than in Europe. I had a good many talks about it with other chemists, and made up my mind that it was a thing to be carefully studied. I found that in general, grasses that were grown on the richer soil were richer in nitrogen. That had been known before. We found that when we manured our soil tolerably well there was the largest quantity, and a small quantity comparatively where the opposite was true. Now, I think that is true of a great many farmers. They find in general that when they do manure they get crops which in their proportion of nitrogen and in their proportion of protein correspond very closely with the averages of the analyses made of the European product, where the agriculturists manure more richly and till more thoroughly.

The PRESIDENT. I will request Prof. Ballou to say something to you now.

Prof. BALLOU. I will give you a slight outline of the course of study that I have under my direction at the college in order that you may have some idea of what we are trying to teach. One of the things that takes my time and attention concerning the young men in the college is the matter of military drill. We are entitled to have a United States army officer. We had one such officer detailed to come to the college, but he asked to be excused because we did not have any suitable place for him to live with his family. The young men get instruction in military drill, and they are required to be on hand

three times a week. We endeavor to make them stand up straight, walk with some energy, and at the same time ground them in the principles that would be necessary for them to know if they were to enter an active campaign; that is, discipline, obedience to commands, respect for superior officers, and so on. It seems to me in this we lay a foundation for any young fellow's career.

In addition to that I have charge of the teaching of botany. We endeavor, so far as possible, in the freshman class, which has botany one hour a day five days in the week, to teach by objects rather than by the exclusive use of the book. We bring in materials, and so far as it is possible, have them arranged in a collection, and then study them. The students do not study the book, and cram their heads with a lot of dry scientific detail and Latin names that somebody has written down there for them to learn, but they study the plants direct from nature, and whenever they see some particular thing which has any peculiarity in this respect, it is generally brought in for me to see, and I refer them to the book for the names. If the book makes a statement, they are asked to say if their experience will bear out that statement. We endeavor to teach them what influences the growth of plants, what can be depended upon to retard or help growth, and which will actually suspend growth, etc. Then, in addition to that, they collect a Herbarium. In this way we have gone over a good deal of ground. The study of grasses is quite important, and this has come under Prof. Phelps.

In the senior year we try to do something in botany with the microscope, showing the relation of the lower plants to the higher, and the steps of gradation by which it is generally supposed the evolution of our higher plants has come about. Our idea is to give them the study direct from nature, so that instead of being full of the names of plants and of parts that do not mean anything to them, they may be able to read intelligently about the growth, assimilation of plant material, and

propagation of plants. We try to show the process of reproduction, so that they may have an intelligent idea of this under certain conditions, according to the plant.

The PRESIDENT. We will now ask Prof. Patterson to give us some information relative to the work he is doing.

Prof. PATTERSON. Mr. President, Ladies and Gentlemen: I have been exceedingly interested in attending these meetings, and listening to the lectures which have been given; they have been of intense interest to every farmer. I have noticed the great numbers of old men that attend these meetings, and I have noticed a look of anxiety upon their faces as though they thought there was something wrong with agriculture. I doubt not that many of you have shed tears when you got to the old ancestral home and found there simply an old cellar and the old well and the bunch of hollyhock, that all reminded you of the old home, and of those who lived there, but who have departed and left the land to their successors. What is the matter? Is this great industry of agriculture going to be a thing of the past? I shall not attempt to discuss this question. Now, there is one thing I want to say in regard to the industry that I represent at the State College. You may consider it entirely foreign to agriculture, but you will find it is of the utmost importance. Agriculture has never developed and never can develop except as it walks hand and hand with the mechanic arts. From the first time that agriculture came to be a pursuit it has been dependent for the implements with which it has been conducted upon the mechanic arts. The mechanic arts have developed the great interests of navigation and transportation which serve you today by carrying your products to the markets of the world.

Now, in regard to the work that is being done at the college. I have the charge of instruction in the mechanic arts. You will see something of what our young men are doing in practical wood work and practical iron work at the other end of the hall. We have some samples of it there. That is all taught in this department of mechanic arts. It is not

taken up as a special branch, but in order that a young man may have that skill and that knowledge which will fit him to take care of machinery and the mechanical implements in use upon the farm. You will find that if a farmer knows something of the mechanical construction of his mowing machine, if he knows how to keep it in order so it will operate all right, then in case of breakage or accident he is able to repair it, where, on the other hand, he would have to spend the time to take it to the repair shop and lose the use of the machine. Many times in such cases if a farmer has a knowledge of the construction of the machines which he has in ordinary use, he can repair them upon his own premises and in a short time have the machine working, whereas if he is unable to do any such work himself he may be delayed days at a busy season by having to send it to the manufacturer for repairs. All this is important to the farmer. It is not the least important among the many things that are considered of vital importance to agriculture.

Secretary GOLD. I wish to say a few words before we adjourn. Some of us have seen the beginnings of all these institutions we have brought before you to-day; we have been right at the foundation of them; you have had the privilege of listening to some who have been early and successful workers in the cause of scientific agriculture, agricultural education, and to their worthy successors. It is a gratification to us that the work will be left in good hands when we are called hence. Talk about agriculture being slow! Why, agriculture has been lively. Look at the advance in knowledge during the lifetime of some now present. The farmer of the present and future has opportunities that we can hardly conceive, even with the widest stretch of imagination. The work of this convention brings before us some of the progress that has been made. The aspect for the future is hopeful.

Convention adjourned until 7 P. M.

EVENING SESSION.

Friday, December 15, 1899.

Convention called to order at 7.15 P. M., Vice-President Seeley in the chair.

Secretary GOLD. We will have the question-box first. "Can you tell us how to rid the house of that disagreeable pest called the water bug?" Where is our entomologist to describe to us the water bug, and what we shall do to get rid of him. Prof. Britton, can you tell us?

Prof. BRITTON. There are various ways of getting rid of him. One way is to shut up the rooms and fumigate with something that will kill the insects. Another way is to spray with something like benzine in and near all the cracks and crevices. A great many people use borax, putting it around everywhere. The first means is the most efficient remedy when the house is full.

Secretary GOLD reads: "Is any cold storage where only ice is used of much use in keeping fruit?" Mr. Platt, what have you to say about that?

Mr. PLATT. I never have had experience myself. There was one gentleman in the town of Cheshire who tried to keep Bartlett pears, and they came out in very good shape. I think you have to have a special house with a great many thicknesses of paper to use ice successfully. And it ought to be sealed up.

Mr. IVES. Mr. Bishop of Cheshire built him a fruit house for the keeping of apples, and I understood that he never put any ice in it. He simply put the apples in in the fall and protected them from frost. My idea would be that for keeping apples perfectly, perhaps the temperature could not be worked even enough or low enough with natural ice. One of the merchants in New Haven who puts in a supply of apples in September said that he calculated to have them kept at a temperature of thirty-four degrees. I have heard that there

was practically no change from that from the time they were put in, but, of course, that was not done with ice.

The PRESIDENT. Isn't it a fact that this chemical process is going to supersede cold storage by ice, and is it not far preferable in every way?

Mr. PLATT. That is my idea.

Secretary GOLD. How was the cold produced in that instance?

Mr. PLATT. By machinery and chemicals.

Mr. IVES. Is it not possible to keep it down below thirty-four degrees with ice? What is the limit of the cold storage temperature? Or what temperature is the lowest that can be maintained and keep apples perfectly?

The PRESIDENT. I do not think it should get much below thirty-two degrees. They are apt to freeze.

Secretary GOLD. Mr. Hoyt, can you tell us anything about cold storage?

Mr. HOYT. I do not know from experience. I know in the western houses that they use chemicals. They have immense houses in the west for cold storage purposes, but they do not tell anything about their process. I know, however, it is all done by chemicals, ammonia and ether, I think. The temperature is kept down to about thirty-four degrees very readily. That is done without ice.

The PRESIDENT. I have seen apples come into the New York market in May just as perfect and seemingly just as sound as when picked in the fall. I should imagine though that they would not keep long when exposed to the air.

Secretary GOLD reads: "Is the Rome Beauty apple worthy of cultivation here?" Mr. Hoyt, can you tell us about that?

Mr. HOYT. It is a variety that we do not grow in the nursery. I never have seen it growing here.

Mr. N. S. PLATT. I do not think it has been grown here to any extent. I saw a plate of them this fall. My impression is that it is not fit to be grown north of its home. It requires

a warm climate. It is an apple which is talked about a great deal in the west. It is quite common there, and raised there.

A MEMBER. You were discussing the keeping qualities of fruit. I do not know but what some of the Professors here can explain why our fruit decays so much quicker than California fruit. They can ship peaches and apricots and pears, and have them here in our market, and you rarely ever see one decayed.

Secretary GOLD. There are peculiarities about the climate and climatic conditions that affect not only their fruit and its keeping qualities, but also their meat and fish in their markets. As far as my knowledge goes, they do not have ice in their markets at San Francisco in keeping their fresh meat, but the keeping of it is due to atmospheric conditions and the dryness of the air. I think that goes far to account for the preservation of their fruit. Then, again, we understand that some of these germs of disease attack our fruits and cause them to decay.

Secretary GOLD reads: "What help to an apple tree will a winter spray of copper give?" And what to a peach tree?

Prof. BRITTON. The spraying in winter is practiced to quite an extent among some fruit growers. It was formerly recommended for the apple scab and one or two other fungous diseases which pass the winter in the spore stage, and if the trunks and branches of the trees are sprayed with a solution of copper sulphate it will kill these. Of course in summer work it cannot be applied in this way. Copper sulphate alone will destroy foliage, and hence we put lime with it and make what is called Bordeaux mixture. In the winter time there is no foliage, and a strong solution can be applied without injury. It is a good thing to spray all kinds of fruit trees in this way during the winter months.

Secretary GOLD reads: "Should a farmer in Connecticut, who can do either, be advised to devote himself to general farming, or to special crops? Which offers the greatest money gain, and which offers the greatest comfort?"

Mr. HINMAN. That question was brought up by one of the speakers the other day, and general farming advised. I suppose that a general farmer is more likely to be sure of a living, but I believe that the man who makes the most money is the man who adapts himself to a particular specialty that he takes up. He is liable to get richer out of it than an all-around man. The man that makes a million, as one of our speakers told us, has got to make a specialty of something. It is true he told us that that man he referred to became bankrupt afterwards, but there are those chances always with specialties. I believe in a general way throughout our State that the safest and surest thing is for a man to raise what his land is adapted to, whether it be onions in Wethersfield or peaches in Glastonbury, and at the same time keep a general crop on his farm, or such crops as will insure him a livelihood. Then, if he makes a thousand dollars out of his special crop he is all right, or if he fails, he has got the other crop to fall back on.

The PRESIDENT. I think Prof. Brewer answered that question very thoroughly the other day, and he stated that on the average it was far better to cultivate a general farm than a specialty.

Mr. HOYT. I think it depends on what that specialty is. I don't think that one should raise all wheat, or all corn, or all beef as specialties. I think if a farmer is going to pursue general farming as it is followed here in the east, he will get more comfort and pleasure by raising his home supplies than, perhaps, profit out of general farming. There is one thing that the farmer wants to learn to do when he is making money, and that is, not to spend it. If you have got to buy everything that you want, except some special crop, the bills for other necessities will be larger than the amount the specialty will bring in. A farmer should study to raise all he wants so far as possible, so as to take what money that comes from what he does sell for himself, and not have to take it to pay for what he has got to have. Raise all you can, and save all you can.

I think that would be the correct system for the farmer to follow if he wants comfort, and also wants to make some money.

Secretary GOLD reads: "Are we to fear a disastrous effect on fruit trees this winter on account of the dry autumn?"

Who is the prophet who is going to look into the weather of the future so as to be able to answer that question? It is the last one in the box.

Mr. HOYT. My answer to that would be not to borrow any trouble.

The PRESIDENT. The next on the program is the subject of The Farm Garden. Mr. Hinman is no stranger to this audience.

THE FARM GARDEN.

By R. S. HINMAN, STEVENSON.

Most of you have read of the farmer who gave his son a college education to make an intelligent farmer of him. Having gotten some idea of the son's knowledge of Latin, the old man said to him one day, "you take that forkabus, and pitch that manureabus into that cartabus, or I'll break your lazy backabus."

At home we practice and learn, but the State Board of Agriculture does not put us at work here. We are given thought instead. At this meeting we have been told of the sea and the wonders thereof; of facts and fancies of education and elocution; all as it should be, in the line of higher and better thought than we should receive in our every-day life at home.

It is my purpose at this, the last session of our meeting, to call you down, and ask you to nestle close to the breast of our great mother, "earth." If you follow me in garden work you must get right down on your knees to the plants you wish to grow or to get rid of. I shall hold you but a few brief moments, and then Mrs. Sherwood will lift you up and prepare you to return to your homes with pleasant thoughts of sweet and beautiful flowers, and a memory of the meeting of 1899 that will be a joy to you for months or years to come.

In advocating the farm garden, far be it from me to throw discredit on the time-honored kitchen garden with its path

down the middle, bordered by tufts of phlox and stately hollyhocks, and, possibly, a row of currant bushes; with its bed of sage, its clump of fennel in one corner, and scattering roots of dill and poppies.

Such a garden has its uses, and if it were not so very useful in a cent-per-cent. way there should be such a little patch by every farmhouse, just as there should be a hearthstone in the house. In a warm sheltered corner of such a garden you can grow a splendid bed of early lettuce if you have netting about as fine as mosquito netting to keep the little chicks out. You can grow beans and summer squashes, as chickens will not molest the beans and will pick bugs from the squashes, and every time a chicken is a help in a garden it should be made a note of.

Possibly you can grow cucumbers also in your kitchen garden, but I have known a chicken, small enough to crawl through a picket fence, to pick off all the little sets.

The farm garden is quite a different thing. There is no sentiment about it unless you have a fondness for seeing things grow, and such things as you do not, possibly with painful thoughts, have to cut the heads off as you do off little ducks and chickens when they are grown.

To some people it is a pleasure to see a row of cabbages grow and develop great succulent heads, and you can decapitate a cabbage without hurting your feelings. Such people can find pleasure as well as profit in the farm garden.

The location should not be too remote from the farmhouse, and should, if possible, be where the farmer passes it almost daily as he goes to or returns from other parts of the farm.

I once knew an old gentleman that asserted that nothing made pigs grow like standing by the pen and watching them. His idea was that the pigs saw you took an interest in them and were encouraged to do their best. He probably did not count the nubbins of corn and handfuls of apples that went along to amuse the pigs while he watched them. A garden, like the pigs, thrives by being noticed.

It matters not how often a man that takes an interest in his garden goes through it, he will find a weed he can pull out or a plant he can set up every time. A plot that was planted the previous year to some crops like corn or potatoes is preferable on most farms to turf ground.

Having selected your ground, an acre more or less as you

can spare and care for, at least sixteen rods long, and twenty is better, plow it early and top dress with stable manure.

You will not plant it all at once, but, if properly handled, it will be all the better for the early plowing and fertilizing.

You can put in some early peas, not the best in the world, but better than none, at once. Plow a furrow the length of your garden, and plow back in the same furrow to deepen it.

Drive along this furrow with a load of stable manure, no matter how coarse it may be, and scatter some in the furrow.

Sow a pint of early peas in the first forty feet, scattering a little soil over the manure in advance, if you like. Cover the peas two inches, and fill up around the vines as they grow. I get Hawley's Improved East Hartford from Hartford for the first.

They need bushing, but will grow if the ground freezes hard after they are planted, and you will have peas. If you begin early in April you want to plant once in ten days for a succession until May. If the new pea, Gradus, will come up while the ground is cold you want no other early pea, but it is a green wrinkled pea of large size and delicious flavor, and it is too much to expect that it will sprout in very cold ground as the smaller smooth pea will. The first week in May plant a pint each of Gradus, Telephone, Juno, and Heroine, leaving room for two additional pints of Gradus planted at intervals of a week. The Gradus is not only one of the best, but is the quickest growing pea I know of, and your three plantings will be out of the way before the others come on. The others mentioned will give you a succession, and if about May 15th you plant a pint of Champion of England, you ought to have peas for quite a while.

I planted nine kinds last year to see which I liked best and give you the results. The Gradus and East Hartford Early, both mature the crop quickly. I had peas for four dinners from a pint of Gradus, all in a week. I planted Abundance and, what proved to be the same thing with me, Horsford's Market Garden, a month earlier than I planted the Gradus, and while I began picking little pods of little peas about the time I picked the first Gradus, I never got enough for dinner at one picking, although I planted a quart. When, however, the Gradus had been gone a month I could still find green peas by hunting long enough on the others. If you like a very dry, almost mealy, although tender pea, the Queen

will suit you. We gave some away last summer that were pronounced, by the city people who ate them, the best of the season, but, possibly they had not been for weeks eating Gradus, Telephone, and Heroine. The Juno, while, possibly, not so good a pea as the Telephone and Heroine, comes between them, and is pretty sure to pay for picking. The Telephone and Champion of England want brush six feet high, the Gradus three feet, and the others two and one-half feet.

You want to use a crowbar and set the brush yourself, if you have planted the peas as I say, or when the vines are loaded they will droop to the ground and spoil many peas. Remember that these peas all grow, and a pint is seed enough for forty feet.

In the meantime, while we were in the garden with the plow preparing to plant our first peas, it would have been a good time to run a shallow furrow for beets, early onions, etc. Put your beet seed in an old stocking or wrap them up in cloth and dip in warm water. Put them in a warm place near the kitchen stove, and if they get a little dry dip them again.

The first time you try it you will probably open the package to find the seed bound fast by little roots, but after that you will watch them and plant just as the little white rootlets begin to show. You only want to put in about forty feet at a time, thick enough so that you can pull out some for greens, and sow a scattering of Early Deep Scarlet Turnip Radish seed in the drill. The radishes will mark your row and be out of the way in time for the beets to grow if you pull them industriously. Sow your beets once in ten days for a succession, and don't forget the radish seed. I was brought up to think a radish was an indigestible, innutritious, and useless thing, but I have always eaten them when I could get them, and squared the results with my early teaching by thinking that I was tough.

Last summer we struck a new experience. A young lady came to us from the city that was, to use an expressive horsemen's phrase, "off her feed."

She tried various things, but settled down to rye bread and butter and radishes three times a day. Sometimes she drank a cup of coffee or tea or a glass of milk, but it was on rye bread and butter and radishes that she waxed fat and regained her appetite.

Understand that the radishes were not withered, pithy

things, but were pulled every morning, washed, and those not needed for breakfast thrown under the icehouse where the ice water dripped through on them.

When you are getting your early onion sets, don't forget a quart or two of rareripes, and stick these first. Where there are young people in the family I would not endorse the onion as an appetizer at the last Sunday meal, and there are people that do not like onions, and others that onions do not like; but for those who can eat them they are a most excellent vegetable. Put your early onions in rows and cultivate with the rest of your garden. The rareripes, and, possibly, some of the onions, will be out of the way in time for setting celery, and as the onions need plenty of fertilizer it will be all the better for the celery. If you have another place for celery a little lettuce and endive seed will give you excellent late salads. You will need to be to some little trouble, however, to get good endive, as it needs to be tied up when it is as large as a nice spreading dandelion, for blanching, and you can blanch but little at a time in warm, moist weather, as the tender leaves will rot.

We must not forget all this while that by the first of May we should plant some sweet corn. If you plant the small early kinds make the ground very rich. The ears are only nubbins at the best and, unless they are full size, amount to nothing.

Besides that, the roots are short and do not hunt for plant food as larger corn roots will.

Planted side by side with the same fertilizing, Evergreen or any of the large varieties will give you plenty of good corn, while Early Cory has no ears on worth picking.

Your corn should occupy a strip the length of your garden, at least sixteen rods, and wide enough for five rows. By the tenth or fifteenth of May you can plant Perry's Hybrid, Early Mammoth, Hickok's Hybrid, and Evergreen for a succession, and once a week until July 1st you should plant to carry you through till frost time. At the first planting about fifty hills of each of the kinds named will supply you, and of the later plantings, if a good variety like Hickok's is used, twenty-five or thirty hills will do.

Plant each kind across your strip, as, if you plant one

row lengthwise, a cross wind may blow away the pollen, thus giving you scattering kernels on the cob.

Bush beans for snap beans can, as I said, safely be planted in the kitchen garden. For late snap beans I plant some of the pole varieties along a wire netting fence, of the coarser kind, that divides my kitchen garden from the street. Beans are not particular about the soil, and the fun those beans have trying to cover the fence keeps them growing and bearing until frost kills them.

Lima beans need more room. They are excellent as green beans, excellent to make succotash of, and I have a Waterbury friend that insists that "succotash is the best vegetable that grows," while as dry beans for baking they are quite as superior to any other bean. You are not likely to have too many.

If I lived in a city where bean poles did not grow, and had a garden, I might plant some of Burpee's Bush Limas. They are genuine Lima beans, but I had rather set poles than bend over to hunt for them.

We grew them last season, but it was so much trouble to get a "mess" that there were few of them picked green, and the ripe ones will get baked.

When you are ready to set celery run your plow back and forth until you have a deep trench, widen and deepen it a little with a shovel, and put in two or three inches of good stable manure. Cover this with earth, enough to set the plants in, and, if you can do so handily, it will pay to water it if there are not frequent rains.

I sprinkled some celery with a dozen pails of water many nights in succession last summer. It was rather a tiresome windup of a day's work; but, a city lady, visiting us late in the fall, said we had the best celery she ever saw in her life.

Tomato plants, cabbage, etc., are excellent to fill spaces with, but I would not put tomato plants where corn or pole beans will shade them. They will grow fast enough, but will not ripen.

There is one staple that I have skipped that should have been attended to early. The chances are ten to one that if you have an old-fashioned asparagus bed you never have all you want. Plow trenches on the edge of your garden, far enough from the fence, and far enough apart to plow between,

as deep as you well can; put in some manure and cover with earth as for setting celery, set about five hundred plants, and cover the crown two inches. As the plants grow fill in around them, keep the weeds out with a plow and cultivator, and see how easy it is to grow asparagus enough for yourself and some for the neighbors.*

Your early peas, beets, onions, sweet corn, etc., will be up and growing in some cases weeks before the later plantings fill out the rows. Cultivate the rows just the same or, where trenches will not be filled, cultivate all the ground not planted. You can kill weeds just as well, and when you are ready to plant or set out plants your ground is in fine condition. Little time is lost, as the turning about takes up half the time. I planted some corn last year where other things were too large to run a cultivator through and never hoed it but once, but it grew nicely. The ground had been thoroughly cultivated up to the time of planting, and that answered.

Of course you will want some strawberries, but don't lumber up your farm garden with them if you can help it. If you are sowing oats and grass seed after other crops on a piece not too far from home, plow it early, top dress it with stable manure to insure your grass catching, and along the north or west side, under the fence, put a little more manure on a strip about eight feet wide, and harrow it thoroughly. Strawberry plants by the dozen are expensive luxuries, but by the thousand they are inexpensive. If your field is forty rods long you can squeeze a thousand plants into two rows. I set a thousand plants that way last year before I was ready to sow oats. They got the benefit of early spring rains, and the first new leaves started in those rows.

We never watered them during the dry weather that made so much trouble with late set plants last spring, but, as opportunity offered, ran the cultivator between and outside the rows. If you think it doubtful whether we have strawberries there next season come and see me the first week in June.

We shall probably have more than we want, but there was not much geeing about in cultivating those rows, and the ex-

* Since writing this paper I accidentally came across "Farmer's Bulletin No. 61," U. S. Department of Agriculture, and advise every one proposing to plant Asparagus to send for it before selecting ground or ordering plants.

pense of caring for them was little more than caring for a little garden bed that we must fight the birds off to get a scant supply for ourselves. Beside that, if we have more than we want, "there are others," and when the grass overruns the strawberries it will all be meadow.

There is another thing that you may have in or out of your garden, — a melon patch. Select a well drained piece of ground, sandy if possible, and get half a dozen different kinds of watermelon and muskmelon seeds, early and late. Melons like warm weather, and if they get set back by cold weather after coming up, they start again slowly, but not surely. Wait till late in May or the first of June, and then, having tilled your ground well for your watermelons, dig holes as big as a bushel basket, ten or eleven feet apart, and fill nearly to the top with stable manure, and tread it down. Cover with two inches of earth, sprinkle on plenty of seed so that the bugs and cut worms can have some, and cover. Thin your plants down to half a dozen when they get a third leaf, and when they begin to run pull out all but two. The authorities will tell you to use well rotted manure, and if you can afford to waste half of your manure before using it, do so. I gave a friend of mine a watermelon last summer that weighed fifty pounds, grown with manure right from the barnyard, and the same hill bore a lot of melons weighing from twenty to over forty pounds. Muskmelons want the same treatment, but the hills need not to be so large nor so far apart.

Winter squashes, Hubbard or Faxon, which is possibly a little better, are grown in the same manner, but if you are to save your own seed each variety should have a corner in the corn or potato field by itself.

I haven't mentioned anything in the way of a fertilizer yet except stable manure, but I use, on almost everything that grows in the garden, a sprinkling of commercial fertilizer after planting. I have an idea that the bugs and cut worms are less troublesome when the top of the ground is dusted over with potash and other stuff that we buy, and the plants seem to rather like it.

Now, some one may feel like inquiring, What do you do with all the corn and beets and peas and other things that you grow, and where is the profit? Well, I'll tell you. We have

to eat at our house, and what we don't grow we have to buy and pay cash for.

During the summer we have extra help and the butcher's bills are heavy, but nothing like as heavy as they would be if we could not fill the men with peas, beets, green corn, radishes, and other things from the garden.

Some of these things from the garden may whet a man's appetite, but they abridge his capacity, while they cost less than beef or lamb from a butcher's cart. If I try to grow just enough of any given thing for ourselves I am always getting left. The housewife might just as well count her potatoes and try to put just enough for the meal on the table. Then, again, nothing need be wasted. The only thing that I grew in my garden last year that proved a dead loss was some radishes that I left to go to seed. The things grew as big as beets, but made no effort to produce seed. We sold sweet corn, at a cent an ear, enough to more than pay for growing the corn, and as fast as the good ears were picked the stalks and small ears went to the cows instead of sowed corn. If you market for yourself to consumers you will find that an occasional basket of string beans or peas, just picked, will do no harm, especially if you are getting top prices for what you sell. If you sell these things, by-products to you, worth little or nothing if left at home, never undersell people who make a living by growing such things. It is fair neither to the truck-grower nor your customer. You know "to err is human," and if you sell a peck of peas at half price the good woman to whom you sell them will tell her regular market man the first time he comes along that she can buy peas of you much less than he sells them.

This might be all right if you kept on, but you will not, and the next time the market man has only what peas he knows he can sell, probably the very day the good lady has company and wants a good dinner, he will skip her.

The next time he calls she will take him to task for disappointing her, and he will plead as an excuse that he thought some one was furnishing her peas for less than he could, and winks the other eye. I have known so much trouble occasioned in this way that I say, give away anything you please, but when you sell, sell at market rate. If you do not do your

own marketing whoever does it for you will find it to his as well as your advantage to add to the variety of his stock.

The man who goes to market with butter only will often lose customers to one who sells fresh eggs, cream, and seasonable vegetables.

No customer, especially if it be a woman, likes to buy every ten minutes of a morning a dozen eggs of one, a few pounds of butter of another, and some vegetables of a third, while, if she wants a pint of vinegar that " her farmer " could as well have brought to her as not, she must go or send to a grocery and get some sort of acid, but rarely vinegar. We have a neighbor that so well understands this that if a customer of his wants a few turnips, apples, or a field pumpkin that he does not have, he comes to us and pays us what he gets, refusing a commission, because he says it is an accommodation to him and to his customers.

While I am talking of marketing let me say, if you sell to consumers sell at retail price. Very many farmers when they go to a town inquire what the stores are paying for what they may have and proceed to retail at these prices. This is not good business. No manufacturer would think of going into a town and peddling his goods at the same price he sold to merchants. The result so far as the farmer is concerned is, he loses a legitimate profit, or the time spent in peddling, and disgusts the merchant so that he will not buy of him at any price. Many a car load of potatoes, barrel of eggs, and tub of western butter come to our Connecticut towns because of this unbusiness like way of doing business.

But to return to our garden. With the exception of your asparagus, which should be located where it can stay for years, there need be nothing permanent about your farm garden. I have set pear and plum trees in mine, and intend setting more. The cultivation and fertilizing will not harm the trees, and when they are large enough to be in the way I'll call it a little orchard and have a new garden.

There are some things, melons especially, that cannot be grown with us successfully many years in succession on the same ground. One of the advantages of a farm garden is that you can shift it around. Our kitchen garden has no spot in it that I know of where I could grow radishes that would not be wormy or pithy when they were barely large enough for the table.

You will observe that there is nothing particularly new about this garden for most of you. Most of those who attend these conventions have to keep their eyes and ears wide open to catch anything new to them; but there are farmers in Connecticut that may hear or read what I have said to advantage.

You may think it a tough story, but, last summer a farmer living in our neighborhood drove into the yard with two or three little children in his wagon just as I was washing some radishes. Seeing a little fellow looking at them curiously, I handed him one. "Eat it," said the father. "You eat it," said bub, holding it up, and the father explained that the child never before saw a radish. That is the kind of farmers I should like to reach, and tell them how much it would add to their profit, how much it would add to the comfort of their families and themselves, and how much less likely their children, as they grow up, would be to want to abandon the farm if they had a farm garden.

The PRESIDENT. Now, I will ask the orchestra to favor us with a little music, and then Mrs. Sherwood will give us her paper on flowers.

[Music by the Orchestra.]

The PRESIDENT. One of the pleasantest features of this convention comes to me now. It is to introduce a lady speaker. I believe that our annual agricultural conventions have the name of being exceedingly pleasant, and good, and profitable, because they make it a point always to hear from the ladies. It is a great pleasure for me to introduce a lady to you, especially when her subject is such an interesting one as "Flowers, Old and New, for the Home, and for Market." I now have the pleasure of introducing to you Mrs. Nellis H. Sherwood of Southport, who will give us a paper on this subject:

FLOWERS, OLD AND NEW, FOR THE HOME, AND FOR MARKET.

By Mrs. Nellis H. Sherwood, Southport.

Mr. President, Ladies and Gentlemen: Henry Ward Beecher once said that flowers were the sweetest thing God ever made, and after that woman, and, however that may be, while I am glad that the Connecticut State Board of Agriculture has seen fit to place upon its program this subject, I do most earnestly wish that some one far more skilled than I in the art of floriculture had been chosen to present it. It is impossible to form any estimate of the rapid advance made in this art during the last fifty years, but more especially the last ten years, during which time so many new varieties have been introduced. In searching for information on the subject of flowers, old and new, I find that horticulture, or gardening, has been pursued from the earliest times of civilization, and that some of the prime favorites, such as the Carnation, writers mention as having been grown by the Romans, but to what degree of perfection we shall never know.

Time and again it has been almost unknown, but within the last twenty years, I think I may safely say, it has been improved upon and brought to such a high degree of perfection that, to-day, it stands out in all its beauty, the flower of the American people. Among the Romans we read that small gardens filled with roses, violets, and other sweet-scented flowers were in repute, while many of the choicest plants and flowers which we now cherish were cultivated by the ancient Greeks. Horticultural art declined with the fall of Rome, and not until long after did it revive under the monastic institutions. In the 16th century several botanic gardens were founded by the Duke of Ferrara, and, in consequence, many other noblemen had fine gardens of their own. In England pleasure gardens with fountains, and shady walks, with hedges and designs, were known from the time of the conquest, but it was not until the construction of conservatories for the preservation of tender plants that horticulture made such rapid progress, and this progress is largely due to the influence of the various horticultural societies.

In the diffusion of a knowledge of horticulture among the people there has been a steady advance. The leading American journals have each a horticultural department, and there are a number of journals devoted exclusively to this art.

Until the beginning of the last quarter of a century the forcing of roses was not carried on to any great extent, but from that time until the present the rapid increase of rose growers seems almost incredible. It also seems a little strange that the number of varieties grown was much larger then than at this date, when the demand is largely for Bride and Bridesmaid, with American Beauties for the people of wealth.

It is also true that there has been a steady decline in prices. It is only twenty years ago that near my home was a very successful florist who grew roses for the New York market, and (as it seemed to me then) on a large scale, but in these days it would be considered small. I often went through the houses, and my friends would say, showing me some handsome buds of Niphetos, Pearls, and other varieties, "I get twenty-five cents for those, wholesale." I thought sometimes it was exaggerated a little, but in looking up quotations I find that as recently as 1888 American Beauties were quoted at $35 per hundred, and at that price meant almost anything grown on an American Beauty bush, no matter how short the stem; but times have changed, and, to-day, at that figure, Beauty roses must have stems two to four feet in length. There is no yellow rose grown at the present time that for size and beauty of coloring can equal the old "Maréchal Niel." Let us hope that in the near future one equally as good may be introduced, or else the old favorite brought to life. I cannot in a paper of this kind undertake to even mention the hundreds of varieties of roses for indoor and outdoor culture, all beautiful, each in its place.

So many new varieties in all classes of flowers are being so rapidly introduced one cannot keep track of them. You all know what an upward leap the Chrysanthemum has taken. As much of a one, I think, as any one flower I can mention. How the modest little violet has come to the front, too. The great variety of pansies and sweet peas, the many beautiful and odd varieties of Orchids, the decorative plants and palms, the great amount of bulbous stock, geraniums, and bedding plants of every description.

I will not discard any of the old-fashioned flowers. Have a place where you can grow some of them, the old hardy shrubs and June Roses, the Zinnias, the Four o'clocks and Bachelor Buttons, the bright Phlox and Verbenas, the May Pinks, and Sweet Jasmine. How the remembrance of their fragrance carries us back to childhood days when we thought there never could be any other flowers so beautiful. It is certainly a source of gratification to note the interest being taken all over the country among our public schools in the work of horticulture. In many places school grounds are being beautified by the planting of shrubs and laying out of flower beds. Surely it can but have a refining influence on the roughest character, and thus tend toward making better men and women and nobler citizens.

I think those of us interested in flower culture, and who never have studied botany, have missed a great deal. Even the simple study of the leaves of our native trees is intensely interesting. I think this subject was brought up at our meeting last year and ably discussed by Mr. Edwin Hoyt and others. I have in mind a little friend, the daughter of a physician, who very often accompanied her father in his long rides about the country, and when very young, as they drove along the country roads he commenced to tell her the names of all the different varieties of trees they would see, often plucking leaves where they could. When seven years of age, upon showing her a leaf, without a moment's hesitation she could tell you to what variety of tree it belonged. Almost without knowing it the child obtained a fund of knowledge which will be a source of life-long pleasure to her. Surely the children of the country ought to feel proud of their superior knowledge over their city brothers and sisters in regard to the things that are beautiful in nature. Within the past year I had described to me a chancel decoration one Sunday in a Hartford church, when it was said that a new and very choice flower was used called the lace flower. What do you suppose it was? Why, the greatly-despised Wild Carrot blossom. How many of you have ever noticed the beauty of a cluster of the blossoms of the common potato? I do not doubt that we could palm them off on city friends as some new and choice addition to the floral kingdom.

In no one line of floral art has the advance been more

marked than in the demand for more artistic effect in the line of decorations. For instance, in decorating for a wedding, or for any large social affair at the present time, only one or two colors and varieties are used in the same room with palms and graceful vines. Certainly the effect is far more pleasing to the eye than when flowers and plants of all kinds are massed together. In funeral designs the transformation is still more remarkable. It is true that orders and societies still send their emblems, and some of them are exquisite and elaborate pieces of work, but the demand is rapidly decreasing for short-stemmed, wired, and toothpicked flowers of every color made up into crowns, harps, gates ajar, pillows, arm chairs, and all sorts of designs. I even heard of a floral hod being ordered for the funeral of a stone mason. In their places we have the ever-beautiful wreath, the flat bouquet, and loose cluster of fine, long-stemmed flowers, which are certainly far more beautiful.

Now, as to the growing of flowers, whether it be for the market or for the home, surely it is one of the most delightful and interesting occupations that can fall to the lot of a human being. I do not believe there is any one thing more educating or refining to the character; for who, day after day, could work among the beautiful blossoms and remain untouched, uninfluenced by their beauty? To be really successful in growing flowers for market I think one must love the flowers, and love the work. Competition is the life of trade, and I would not discourage any one of you from entering the ranks, but if you do so with the idea that it is nearly all profit, you will be greatly mistaken. I know this to be so, although I am not the grower of flowers in our firm. I only add the last finishing touches in arranging them, do the fancy part of it, but I think any florist will tell you that this feature of the work plays no small part in the successful marketing of flowers. After your houses are built, and well stocked with thrifty plants, there is a great deal to contend with. Plants of nearly all kinds are subject to disease, and to cope with this is a constant fight. I read an article recently stating that pills are now administered to plants for some forms of disease. They are incased in a capsule, inserted at the root of the plant, and it is said they will dissolve and be digested as needed. So you will see that the growing of flowers for market is by no means easy work. It calls for constant, unceasing care from the hour that the tiny cutting

is put into the sand to root until the perfect blossom is packed ready for shipping. It means very often sleepless nights when the weather is extremely cold. An hour's neglect at such a time may mean the loss of an entire crop of roses, or carnations. One who has made this subject almost a life-long study has said: "The value of a flower depends upon the rapidity with which it can be placed before the customer in a condition that it will last the longest and give the purchaser pleasure. The quality which produces the high price for the flower begins with the grower, and extends through the growing, cutting, and hardening the flower and packing it for shipment, as well as the treatment it receives after it arrives upon the market. A failure in any one of these important details will defeat the end desired."

In growing flowers for market I would say aim always to grow the very best of its kind. For first-class flowers you will always find a ready sale. They should be packed and arranged with the greatest care so when the boxes are opened they will at once attract the eye of the purchaser. Blossoms of all colors and kinds are no longer massed together as they were a few years ago, and I think you will agree with me that the bunch of roses or carnations of one, or two at the most, solid colors is much more beautiful. As to the kind of flowers one would raise, each must judge for himself, and according to his or her taste in that line; whether it shall be the graceful rose (the choice of most purchasers I think, with well stocked purses), and surely there is no flower more beautiful when brought to perfection in our hot houses in mid-winter. I suppose some of you can scarcely believe me when I tell you that there has been on exhibition before the Florist Club in New York city a bunch of American Beauty roses with stems ten feet in length. Will you undertake these? Or shall it be the Carnation, especially desirable for its good keeping qualities, its spicy fragrance, and the reasonable price demanded for it? The Lily in all its purity and stateliness, the Little Purple violet that fills the air with its delicious odor, and which for the past few years has been in great demand for personal adornment by women of society, and the numerous kinds of bulbous stock that are forced in the hot houses, and unfold their waxy petals in the cold, dark days of winter, and always command good prices.

And I could mention a hundred other kinds, all salable if well grown. I would not leave out the beautiful Sweet Pea, which is now grown in such great variety, and the Chrysanthemum, the glory of the autumn season, and of which the poet has said:

"With summer and sun behind you
With winter and shade before,
You crowd in your regal splendor
Through autumn's closing door
White as the snow that is coming,
Red as the rose that has gone,
Gold as the heart of the lily,
Pink as the flush of the dawn.
Sweet is your breath as of spices
From a far sea island blown;
Chaste your robes as of vestals
Trimming their lamps alone.
Strong are your hearts and sturdy
The life that in root and stem
Smoulders and glows till it sparkles
In each flowery diadem."

A gentleman visiting our place one day said to Mr. Sherwood, "What will you do with your houses, should flowers go out of fashion?" I cannot imagine such a day ever coming. They have been in fashion ever since the garden of Eden was planted, and I think will so continue while time shall last.

I am going to say a word to you gentlemen, now, in regard to flowers in your homes. The time has gone by when it was considered by some men that flowers belonged only to the women folks, and that if a man looked or made much ado over a flower he feared he had somehow lowered his dignity, and might be thought womanish. When I meet a man in these days who can see no beauty at all in any kind of a flower, I conclude there is something wrong, something lacking in his brain. You do not realize how much we think of flowers. So, if you do not raise them for market, raise them for the pleasure of your family; make the grounds around your houses attractive with well laid out flower beds and shrubs, and even have them in the back yard. I think if a woman has to be in the hot kitchen all the morning, as some farmers' wives are, it makes one feel bright and cheerful to gaze out on a pretty

flower bed instead of rubbish and a littered up back yard. So let your wives and sisters have all the flower beds they want. If you cannot afford to have a florist come and lay them out, suppose you dig and prepare the ground yourselves ready for the seeds and plants. I think you will feel amply repaid, as you sit on the piazza in the evening twilight, after the work of the day is over, and gaze out on the bright blossoms. It will bring pleasant thoughts to your mind as you think how the cares of the day have been made lighter for the busy wife, all because of those flower beds, which are to her a source of continual joy.

I have one more plea, and that is for your children. If they have any taste for this work encourage them all that you can. Give them a small piece of ground which they may call their own, and a little money to buy a few seeds and plants. The cultivation and care of them will inspire in their hearts a love for all that is beautiful, and as they carefully watch and tend them from seed to bud, and from bud to blossom, they will learn one of life's sweetest lessons. The experience gained will be of lasting benefit should they ever decide to take up the work of horticulture, and this little beginning be but a stepping stone to something far greater than you can imagine. Flowers are appreciated and enjoyed by poor and rich alike, the single plant or blossom often affording as much (and I sometimes think even more) pleasure in the home of the poor than does the well filled conservatory in the palace of the rich man. If you do not believe this, perhaps next spring when the beautiful lilacs are in bloom, some of you ladies may take a trip to New York by boat. If so, suppose you carry with you a nice, large bunch of the fragrant blossoms. Land at the down-town pier, and you will not have a chance to walk very far before you are fairly surrounded by ragged urchins who will beg for "just one blossom, Missus."

I sometimes wonder if those who possess great wealth ever realize the pleasure they might give to others not so well favored as themselves by remembering them, and especially those who are sick or shut in, with a plant or bunch of flowers. It is good for the business too, you know, and I am glad to say that I believe this good work is increasing every year, especially in our large cities. It is certainly wonderful the quantities of cut flowers in particular that are everywhere used. They are

appropriate for every occasion. No wedding festivities are complete without them, thousands of the choicest blossoms often being used for a single occasion. They grace the social gathering, and festivities of every description; welcome the coming, and speed the parting guest. They are the silent messengers of love and sympathy from friend to friend. They bring brightness into the sick room, and make beautiful the spot where we lay our loved ones to rest, and speak to us of a life beyond this,

"Where everlasting Spring abides and never-fading flowers."

The PRESIDENT. Ladies and gentlemen, I wish to propose a rising vote of thanks for this very pleasant ending of a most pleasant evening. Please arise.

Mr. HINMAN. Mr. Chairman, I have a resolution that I would like to present to this convention.

"*Resolved:* That the thanks of this convention are due to the city, town, and people of Meriden, for courtesies extended while we have been as strangers within their gates; to the railroads which have assisted in the success of this meeting by reduced fares, and to the press, and especially to the Associated Press, which has given those who have been unable to meet with us some idea of the feast we have enjoyed." I move you, sir, the passage of this resolution.

A MEMBER. I move an amendment to the resolution by changing the wording so that it shall state that the thanks of this convention are not only due but are hereby extended to the citizens of Meriden for courtesies received.

Amendment accepted by Mr. Hinman, and upon being put by the President, the resolution was unanimously adopted.

Secretary GOLD. I want to say just a word further about this matter of obtaining pictures or photos of remarkable, large, ancient, or historical trees; trees of any kind, forest and fruit trees, clumps of trees, or anything that is characteristic of the tree scenery of our State. If you have any pictures or negatives of such trees be sure and send them to me. I desire to

prepare a collection of photos, and they can better be taken from a negative than from a picture finished up by an artist. Send me the negatives with a brief description of their beauty, or historical interest, the names of the planters, or any other circumstances connected with their history. Although I have appealed again and again on this matter to the citizens of the State, I find that when the list of trees is out there are many of them shut out; many who should have sent me a description of some tree under which they played in their childhood, or some that their grandfather or grandmother planted and enjoyed the fruit or the shade, or some other particular connected with their family or individual history and experience. I wish you would bear this in mind.

The PRESIDENT. There is just one other thing that I want to mention before we adjourn, and that is how the sound of good, pleasant voices does give us courage and hope as we go on our way. Now, we will all arise and join in singing.

Convention adjourned without day.

EXHIBITS AT MERIDEN,

December 13 to 15, 1899.

Pruning Shears — H. L. Jeffries, Woodbury.
Star Creamery Separator — By S. M. Lawrence, Phelps, N. Y.
Col. McFarland, Hale, and Paragon Chestnuts — By J. H. Hale; the two first named being very large indeed; all these were grafted.
Cleopatra Apple Grafts — From J. H. Hale.
Corn — Four varieties from Seaman Mead.
Popcorn — Mrs. N. S. Baldwin, Meriden.
Geo. E. Hough, Yalesville.
Dent — R. S. Hinman; planted June 20th, cut Sept. 10th, and ripe.
Apples — T. S. Gold, 36 varieties.
N. S. Platt, 5 varieties.
Joseph S. Adams, 1 variety for name.
E. M. Ives, Meriden, 8 varieties.
Leroy A. Smith, Higganum, 5 varieties.
J. H. Merriman, New Britain, 1 variety.
E. C. Warner, North Haven, 1 variety.
Pears — Albert Plant, Branford, 1 variety.
Onions — Albert Plant, Branford, 1 variety.
Potatoes — N. S. Baldwin, Meriden, 1 variety.
Nuts — Hickory, Mrs. N. S. Baldwin, Meriden, 1 pl.
Hickory, F. B. Chapman, East Hampton, 1 pl.
Butternuts, Mrs. N. H. Baldwin.
Black Walnuts, Mrs. N. H. Baldwin.

BY CONNECTICUT AGRICULTURAL COLLEGE.

Wood cubes and models, steel drills, cold chisels, screw-drivers, chain hooks, rings and links, made by students. Vines and shrubs rooted by students, fruit trees of various kinds budded by boys and girls, drawings of buildings and figures, collection of grasses, and several herbariums, with many specimens.

BY CONNECTICUT EXPERIMENT STATION.

Two cases injurious insects — one of moths and one of butterflies. Many samples of feeding stuffs found for sale in our markets; also cotton, cotton seed, and various products made from the seed; samples of tomatoes from greenhouse.

REPORT OF N. S. PLATT, POMOLOGIST.

New Haven, Conn., Feb. 9, 1900.

Sec. Gold:

Dear Sir: — You asked for a report from me as Pomologist of the Board of Agriculture. I submit the following:

The year 1899, as affecting the growing and keeping of fruit has been an unusual one in some respects. On the night of January 1, 1899, the temperature fell to from four to twenty or more degrees below zero, according to location. My own thermometer registered six degrees below zero, while at the United States Weather Bureau in New Haven, which is on the top of a high building in the heart of the city, only four degrees below was indicated.

The extremity of temperature was not so great as we often experience, but the effects were soon seen as very disastrous to tender blossom buds, particularly those of the peach.

Examination showed that in most orchards all peach buds were killed except an occasional one in the top of the tree. A few orchards favorably situated had from twenty-five to fifty per cent. of buds alive. The buds went into winter in good condition, and on January 1st were considered to be dormant, no warm weather in fall or early winter to start the sap into them. The disastrous effect was a surprise and was thought to be accounted for by some by the presence of moisture in the buds from damp air and a light snow the day previous. I am inclined to think it was due to the rapid thawing of the buds which took place before noon the next day under a warm sun and dry wind. I am the more inclined to this view because on February 9th, 10th, 11th, and 12th we had temperature at zero or below all the time, and some of the time three to five degrees colder than on January 2d, and no apparent change in the status of the living buds. This time, however, they were three or four days in thawing out.

The freeze in February was more severe and more destructive in the central United States than on the Atlantic coast. From Michigan to Georgia hundreds of thousands of trees were killed or badly injured; most of the injured trees were peach, but there were some of plum, cherry, apple, and pear.

One-half of the bearing apple trees in the State of Iowa were,

according to official returns, killed outright by the cold. A few peach trees in Connecticut suffered and a few died, but they could be numbered by the hundreds, and there were no losses of apple trees. Extremes of temperature are never so great in New England as in the country to the west of it, and this is one grand reason working to our advantage in fruit culture, for seldom do we lose any hardy tree from effects of weather (either winter or summer), provided the tree stands in a proper location.

The foliage on all kinds of fruit trees was unusually full and free from imperfections which are often caused by insects and fungus. Canker-worms, which had been abundant and increasing for a number of years, disappeared, and caterpillars, destructive in eastern New York and Vermont, did not trouble us at all. Many of the common forms of aphis were not prevalent early in the season. The rainfall in April, May, and June was light, and a fungus which often in May turns the leaves on the inside and lower branches of apple trees yellow and causes them to fall did not appear. Wet and cold weather for a week at a time is supposed to cause this.

So with a good foliage right through the season, with a light rainfall and an unusual amount of sunshine, the apple trees of Connecticut carried out to good size and perfection a large crop of apples.

Unusually warm weather in October advanced the ripening process so rapidly that there was a great waste in winter fruit from decay after it was in barrels and in the cellar or cold storage, so that by Jan. 1, 1900, there was probably no more than the usual supply left unconsumed. Our Connecticut markets were for once left pretty much to Connecticut producers to supply, and the consumption was large.

The same warm weather in October which ripened the apples before their time also caused the blossom buds of the peach to swell even before the leaves had fallen, but as weather later was favorable they gradually shrunk back to nearly the normal condition.

There are several firms in the state each of which now have one hundred acres or more of peach orchards under good care. I recall several young apple orchards of thirty-five or more acres each and many lesser ones of each of these fruits, and there is more ground left ready to be taken. Wherever I go

in the southern part of the State at least I see land suitable for peaches.

There is much available land, particularly in the central and northern part of the State, suitable to growing winter apples. I would like to see more orchards planted and well cared for.

Yours very respectfully,

NORMAN S. PLATT.

THE POTATO CROP.

The farmers of eastern Long Island have been gradually increasing the culture of potatoes for fifty years, until for the last ten years it has become their largest and best-paying crop. They usually plant both an early and late variety, thereby lessening the danger of a total failure and extending the season for culture and harvesting.

The seed they generally buy from Maine, northern New York, or Michigan. It pays to change the seed save in rare exceptional years, that from the north producing the best results.

The soil should be mellow, the best conditions being after a corn crop, next after oats, next after a previous potato crop, and last on inverted sod. A poor or lumpy or half-tilled soil produces failure. Our farmers purchase stable manure (brought by railway) and apply say five to ten loads to the acre the previous fall, and plow it in shoal before winter. In the early spring the ground is again plowed, harrowed, rolled, and marked. The drills range from two to three feet apart, if very heavily fertilized made the closer. From eight hundred to two thousand pounds of commercial fertilizer is drilled in to the acre. The potato planter machine drops and covers the potato at the same time. The potato-weeder, a cheap machine, will keep the ground clean early; the cultivator will do it later, at first throwing the soil away from the tuber and afterwards toward it. The crop is dug by a machine called the potato-digger. Low, wet, clayey land is more liable to the rot. Dry land, wide drills, and deep covering lessen this liability.

The yield of early varieties is usually much smaller than

the later, and the condition of the seed, soil, and tillage largely control the amount of the crop. Our most successful farmers cut and reject the clustered sprout end, believing that tends to grow more small potatoes, and plant the pieces containing only one or two strong healthy sprouts. When the seed is cut, to prevent bleeding and thereby weakening they apply plaster or ashes to dry it. In this way the seed can be cut without injury some ten or fifteen days before planting. Growing sprouts broken off weaken the seed. Seed potatoes should be kept in a cool, dark, dry place; if shoveled over every five or ten days in the spring the frequent moving will prevent sprouting and leave the seed stronger. Exposure to the sun a fortnight, more or less, before planting makes the sprout stronger and the new potato earlier. Potatoes thus exposed in a south window planted in my garden on the 28th day of April produced new potatoes fit for eating on the 15th day of the next June. The yield varies from seventy-five to five hundred bushels per acre, averaging say one hundred and fifty bushels. Geo. W. Hallock of Orient, Suffolk County, N. Y., a large and successful grower, has produced in some portions of his crop nearly six hundred bushels per acre.

The application of fresh barnyard manure immediately before planting adds little to the crop, increases liability to rot, roughness, and grubbiness. Commercial fertilizers containing a large percentage of potash lessen this liability, give a paying increase in quantity, and much better quality of product. A high, dry, mellow, well-tilled field, fertilized the previous fall, averages the best-paying crop. The hills and tablelands of Connecticut seem well adapted to the culture of the potato as a crop succeeding corn. But it must be remembered that without abundant fertilizing, care, tillage, the product will not pay. *Nothing from nothing, nothing remains*, is a rule of numbers and of potato raising.

This crop flourishes in a cool season, is worth more per acre than many other crops, belongs to a higher condition of farming, fits land admirably for succeeding crops, is largely planted, tilled, and dug by machinery, employs youthful labor in picking up, and if a total failure the fertilizer remains practically uninjured for that or any other succeeding crop. The early and late Rose, the white and yellow Elephant, are varieties largely chosen by our farmers. Sometimes the whole potato,

if small, is planted after cutting off the sprout end. The forcing process seems to require new seed often. The tendency to take on the local type and degenerate in quantity and quality is observed.

H. P. HEDGES.

Bridgehampton, Suffolk Co., N. Y., Jan. 2, 1900.

OFFICIAL LIST OF FARMERS' CLUBS IN CONNECTICUT, 1899.

NAME OF CLUB.	PRESIDENT.	SECRETARY.
New Haven County,	Prof. Wm. H. Brewer,	Cullen B. Foote.
Cheshire,	Walter H. Baldwin,	Fred Doolittle.
Green's Farms,	W. H. Burr,	J. Frank Elwood.
Greenwich,	S. R. Close,	G. A. Lockwood.
Naugatuck,	J. B. Tolles,	L. W. Kane.
Newington,	H. A. Whittlesey,	J. Kirkham.
New Britain,	L. S. Wells,	.....

CONNECTICUT DAIRYMEN'S ASSOCIATION.

J. B. NOBLE, *Pres't*, East Windsor Hill.
GEO. G. MANCHESTER, *Sec'y*, Station A, Winsted.
W. I. BARTHOLOMEW, *Treas.*, Putnam.

CONNECTICUT POMOLOGICAL SOCIETY.

J. H. MERRIMAN, *Pres't*, Southington.
H. C. C. MILES, *Sec'y*, Milford.
ROSWELL A. MOORE, Kensington.

CONNECTICUT HORTICULTURAL SOCIETY.

J. T. WITHERS, *Pres't.* C. H. BOYKETT, *Sec'y.* C. H. WILEY, *Treas.*

CONNECTICUT JERSEY CATTLE BREEDERS' ASSOCIATION.

S. C. COLT, *Pres't*, Elmwood. R. A. POTTER, *Sec'y*, Bristol.
B. W. COLLINS, *Treas.*, Meriden.

CONNECTICUT CREAMERY ASSOCIATION.

E. A. RUSSELL, *Pres't*, Suffield.
FRANK AVERY, *Sec'y* and *Treas.*, Wapping.

CONNECTICUT SHEEP BREEDERS' ASSOCIATION.

R. S. HINMAN, *Pres't*, Oxford. JOHN H. WADHAMS, *Sec'y*, Goshen.

CONNECTICUT FORESTRY ASSOCIATION.

E. V. PRESTON, *Pres't*, Hartford.
MISS MARY WINSLOW, *Sec'y* and *Treas.*, Weatogue.

THE AUDUBON SOCIETY OF CONNECTICUT.

MRS. JAMES OSBORNE WRIGHT, *Pres't*, Fairfield.
MRS. HELEN S. GLOVER, *Sec'y* and *Treas.*, Fairfield.

THE CONNECTICUT BEE-KEEPER'S ASSOCIATION.

CHARLES H. CHITTENDEN, *Pres't*, Killingworth.
MRS. W. E. RILEY, *Sec'y*, Waterbury.

CONNECTICUT STATE POULTRY SOCIETY.

GEORGE B. FISHER, *Pres't*, Hartford. R. G. BAILEY, *Sec'y*, Hartford.

WESTERN CONNECTICUT POULTRY ASSOCIATION.

E. B. PARSONS, *Pres't*, West Winsted. H. J. PIERRE, *Sec'y*, Winsted.

MERIDEN POULTRY ASSOCIATION.

L. E. COE, *Pres't.* JOSHUA SHUTE, *Sec'y.* W. B. HALL, *Treas.*

NEW HAVEN POULTRY ASSOCIATION.

EDWARD A. TODD, *Pres't.* W. R. KIRKWOOD, *Sec'y.*
EDW. L. JONES, *Treas.*

REPORT OF THE TREASURER.

CHAS. A. THOMPSON, *in account with*
CONNECTICUT BOARD OF AGRICULTURE.

1898.			Dr.	Cr.
July	1.	By cash in treasury,		$704.48
1899.				
Jan.	3.	" State appropriation,		3,500.00
"	"	To Geo. M. Hersey,	$72.90	
"	"	" T. S. Gold,	500.00	
"	"	" O. H. Miner,	37.50	
"	"	" D. A. Rood,	219.75	
"	6.	" Seaman Mead,	23.15	
"	"	" James Wood,	30.18	
"	"	" A. B. Peebles,	9.64	
"	"	" E. J. Miner,	6.76	
"	"	" C. A. Thompson,	36.04	
"	7.	" Geo. T. Powell,	55.80	
"	"	" Frederick Doolittle,	14.86	
"	"	" E. H. Jenkins,	50.94	
"	"	" H. W. Conn,	26.20	
"	"	" Alice Freeman Palmer,	31.25	
"	"	" E. R. Newell,	1.50	
"	"	" Geo. R. Bradley,	21.25	
"	"	" W. E. Britton,	2.91	
"	17.	" E. G. Seeley,	18.00	
Feb.	8.	" Chas. F. Roberts,	75.00	
"	"	" Geo. R. Bradley,	8.00	
"	"	" J. H. Hale,	25.00	
Apr.	6.	" M. F. Latham,	20.18	
"	20.	" C. S. Phelps,	43.78	
"	"	" F. H. Stadtmueller,	4.90	
"	"	" Maude K. Wheeler,	10.36	
"	"	" Edwin Hoyt,	2.50	
"	"	" A. B. Peebles,	4.74	
"	"	" Geo. H. Merwin,	1.10	
"	"	" H. G. Manchester,	3.28	
"	"	" W. E. Britton,	70	

"	"	"	N. S. Mayo,	15.47	
"	"	"	A. G. Gulley,	7.23	
"	"	"	L. P. Chamberlain,	3.12	
"	"	"	E. H. Jenkins,	2.60	
"	"	"	E. C. Birge,	60	
May	5.	"	Henry A. Ballou,	3.31	
"	"	"	E. R. Newell,	1.00	
"	"	"	C. L. Beach,	11.71	
June	30.	"	E. G. Seeley,	9.00	
"	"	"	T. S. Gold,	793.24	
"	"	"	E. Halladay,	11.00	
"	"	"	Seaman Mead,	6.80	
"	"	"	E. J. Miner,	6.76	
"	"	"	C. A. Thompson,	33.68	
"	"	"	The Case, Lockwood & Brainard Company,	267.28	
"	"	"	Balance by cash in treasury,	1,673.51	
				$4,204.48	$4,204.48

This is to certify that we, the undersigned Auditors of the State Board, have examined the above account of the Treasurer and the accompanying vouchers and find them correct.

FREDERICK DOOLITTLE,
SEAMAN MEAD,
E. JUDSON MINER,
Auditors.

Hartford, July 1, 1899.

OFFICIAL LIST OF AGRICULTURAL SOCIETIES IN CONNECTICUT, 1899.

Name of Society.	President.	Secretary.	Treasurer.
Connecticut State,*	Geo. A. Hopson, East Wallingford,	B. W. Collins, Meriden,	Eugene A. Hall.
New Haven County,*	D. N. Clarke, Woodbridge,	.....	Frank S. Platt.
New London County,	James A. Bill, Bill Hill,	Theo. W. Yerrington, Norwich,	Chas. W. Hill.
Windham County,	Chas. W. Grosvenor, Pomfret,	J. B. Stetson, Brooklyn,	P. B. Sibley.
Litchfield County,*	Harry Sedgwick, Cornwall Hollow,	D. C. Kilbourn, Litchfield,	.....
Beacon Valley,	F. S. Truesdell, Naugatuck,	E. A. Hotchkiss, Naugatuck,	F. M. Candee.
Berlin,	Wm. H. Webster, Berlin,	Francis H. Shaw, Berlin,	Francis Deming.
Branford,	Edwin Doolittle, Branford,	John P. Callahan, Branford,	W. R. Foote.
Bristol Fair Corporation,	Ard Welton, Plymouth,	B. A. Peck, Bristol,	B. A. Peck.
Cedar Valley,*	Levi S. Wells, New Britain,	J. S. Kirkham, Newington,	E. F. Blake.
Chester,	Wm. J. Chapman, Chester,	Charles E. Perkins, Chester,	Chas. E. Perkins.
Clinton,	Edwin H. Wright, Clinton,	Clifford H. Evarts, Clinton,	Geo. H. Brooks.
East Granby,*	C. H. Hanchett, East Granby,	Wilbur H. Gay, East Granby,	Clinton Phelps.
Danbury,	Samuel H. Rundle, Danbury,	G. M. Rundle, Danbury,	J. W. Bacon.
Farmington Valley,	Oliver F. Perry, Collinsville,	E. A. Hough, Collinsville,	B. F. Case.
Granby,	Geo. O. Beach, W. Granby,	C. H. Deming, Granby,	L. C. Spring.
Guilford,	Walter C. B. Goldsmith, Guilford,	Samuel Spencer, Guilford,	E. R. Davis.
Harwinton.	Thomas Q. Hogan, Harwinton,	Albert W. Buell, Harwinton,	Patrick Hogan, Jr.
Killingworth,*	D. K. Stevens, Killingworth,	N. H. Evarts, Killingworth,	A. B. Stevens.
Madison,	S. A. Scranton, Madison,	Edward N. Willard, Madison,	E. N. Willard.
Meriden,*	Benj. W. Collins, Meriden,	Geo. W. Fairchild, Meriden,	E. A. Hall.
New Milford,	J. LeRoy Buck, New Milford,	J. Edwin Hungerford, New Milford.	Edwin J. Emmons.
Newtown,	Theron E. Platt, Newtown,	P. A. McCarthy, Newtown,	Henry G. Curtis.
Orange,	Watson F. Woodruff, Orange,	Arthur D. Clark, Orange,	Edward S. Clark, Jr.
Oxford,*	W. B. McEwen, Oxford,	Wm. W. Hughes,	.....
Putnam Park Association,	G. D. Bates, Putnam,	L. O. Williams, Putnam,	A. C. Stetson.
Rockville Fair Association,	Andrew J. Kingsbury, N. Coventry,	Ed. F. Badmington, Rockville,	Francis A. Randall.
Simsbury,	Edmund A. Hoskins, Simsbury,	Geo. C. Eno, Simsbury,	Charles E. Curtis.
Southington,	Geo. L. Messenger, Southington,	Wm. H. Cummings, Southington,	W. H. Cummings.
Stafford Springs,	E. C. Dennis, Stafford Springs,	C. F. Beckwith, Stafford Springs,	H. S. Abel.
Suffield,	Wm. S. Pinney, Suffield,	Egerton Hemenway, Suffield,	J. O. Haskins.
Union (Monroe, etc.),	F. H. Wheeler, Monroe,	S. T. Palmer, Shelton,	D. S. Clark.
Union (Somers, etc.),	H. H. McKnight, Ellington,	Milo Hamilton, Ellington,	C. A. Thompson.
Wallingford,	M. E. Cook, Wallingford,	D. W. Ives, Wallingford,	J. P. Stevenson.
Wethersfield,	Stephen F. Willard, Wethersfield,	Chas. C. Harris, Wethersfield,	Chas. C. Harris.
Willimantic Fair Association,	Geo. M. Harrington, Willimantic,	Fred. A. Sanderson, Willimantic,	Frank Larabee.
Windsor,	H. H. Ellsworth, Windsor,	Geo. M. Wrisley, Windsor,	W. H. Filley.
Wolcott,	H. B. Carter, Wolcott,	E. M. Upson, Wolcott,	E. M. Upson.
Woodstock,	Oscar Robinson, E. Thompson,	H. W. Hibbard, Woodstock,	A. E. Brunn.

*No fair.

SOCIETIES.	Cash on hand.	Single Admission Tickets.	Membership or Season Tickets.	Grand Stand.	Donations and Unclaimed Premiums.	Entrance Fees, Trials of Speed.	Other Entrance Fees.	Rent of Grounds.	State Appropriation, 1898.	Other Sources.	Totals.	State Appropriation, 1899.
New London County,	$6.94	$3,396.75	$107.00	$433.25	.....	$410.00	$74.50	$654.28	$316.46	$69.40	$5,468.58	$280.54
Windham County,	39.76	1,108.25	55.00	106.25	.....	145.00	69.50	291.60	319.18	144.23	2,278.77	292.57
Beacon Valley,	2.60	517.00	78.00	.....	.....	25.00	28.25	20.41	.....	10.00	681.26	126.86
Berlin,	34.84	386.44	95.00	29.60	.....	.....	.....	31.60	139.80	15.00	732.28	131.61
Branford,	137.85	351.12	.....	55.75	.....	70.00	.....	88.31	106.95	45.50	855.48	104.15
Bristol Park Co.,	.....	.....	782.61	62.20	.....	56.00	150.00	136.00	.....	120.00	1,306.81	200.45
Chester,	32.78	88.45	28.00	.....	.....	.....	.....	22.46	102.81	.....	274.50	111.29
Clinton,	97.46	99.00	40.00	.....	$37.75	.....	4.50	34.00	110.55	111.80	535.06	121.91
Danbury,	3,169.21	11,701.21	5.00	2,145.50	.....	1,467.50	1,525.85	4,781.10	1,094.25	539.10	26,428.72	913.06
Farmington Valley,	1,016.49	1,109.18	.....	131.00	.....	320.00	69.00	222.70	181.67	80.50	3,130.54	166.98
Granby,	.....	537.65	.....	.....	36.75	240.00	10.00	99.54	110.74	349.97	1,384.65	106.51
Guilford,	893.87	154.36	81.00	.....	102 65	.....	.....	.....	.....	.....	1,231.88	127.06
Harwinton,	1,64	.....	.....	.....	.....	.....	.....	7.00	371.60	123.96	4.50	508.70
Madison,	.....	53.90	38.95	.....	.....	.....	.....	11.00	120.47	85.00	.....	113.48
New Milford,	300.03	1,076.65	.....	186.25	.....	368.75	.....	230.25	165.65	67.97	2,395.55	157.74
Newtown,	96.50	1,294.00	15.00	435.25	100.00	486.00	15.50	414.70	204.54	199.24	3,260.73	176.38
Orange,	.....	623.82	130.00	141.45	1.00	.....	1.20	458.99	1,356.76	.....	.....	112.48
Putnam Park,	203.04	2,930.39	.....	707.55	.....	1,014.80	56.10	553.80	383.00	1,686.52	7,535.20	194.06
Rockville Fair Ass'n,	962.13	1,657.10	189.00	362.50	.....	640.00	121.95	681.90	197.49	28.49	4,840.56	187.07
Simsbury,	15.44	560.65	.....	.....	.....	280.00	.....	.....	128.48	128.90	1,145.97	119.69
Southington,	.....	572.37	41.50	48.80	.....	200.00	49.00	163.90	205.03	85.50	.....	166.24
Stafford Springs,	1,057.04	3,043.30	225.00	720.70	22.80	572.50	167.75	804.80	464.66	559.59	7,178.14	313.16
Suffield,	164.15	771.70	.....	59.50	.....	295.00	.....	55.00	123.75	154.82	1,623.92	119.74
Union (Monroe, etc.),	176.85	616.95	122.00	59.50	.....	154.00	3.00	98.50	190.26	156.65	1,577.71	144.51
Union (Somers, etc.),	1,242.53	.....	10.00	.....	6.75	.....	.....	37.90	128.72	150.14	1,576.04	128.51
Wethersfield,	.....	90.00	60.00	.....	125.00	.....	.....	.....	.....	59.47	334.47	101.39
Willimantic Fair Ass'n,	364.18	1,412.04	52.00	257.50	.....	575.00	3.50	425.50	132.31	222.85	3,444.88	107.70
Windsor,	.....	148.00	95.00	.....	.....	.....	12.00	.....	.....	.....	255.00	110.77
Wolcott,	1,205.13	534.05	90.00	.....	.....	.....	6.00	96.85	189.90	57.40	2,179.33	173.92
Woodstock,	52.21	706.37	46.00	110.20	6.06	20.00	67.25	178.78	227.64	112.55	1,527.06	178.40
Conn. Hort. Soc.,	38.25	147.70	184.00	.....	.....	38.50	.....	.....	141.59	*2,503.17	3,053.21	137.18
Conn. Dairy Ass'n,	541.60	.....	.....	.....	.....	.....	.....	.....	†169.84	.....	.....	129.58
Conn. Pom. Soc.,	158.58	10.80	125.50	.....	.....	.....	.....	.....	103.02	.....	397.90	130.27

* Sale of stock $1,220.00. Loans, $930.00.

†Annual, $869.75.

RETURNS OF AGRICULTURAL SOCIETIES, 1899—FINANCES, CONTINUED.

SOCIETIES.	Expenses of Fair.	Premiums for Speed.	Premiums for Amusement.	Other Premiums and Gratuities.	Permanent Improvements.	Other Expenses.	Cash on hand.	TOTAL.	Indebtedness of Society.	Real Estate.	Personal Estate.	Number of Members.	No. of Stockholders—Joint Stock.	Capital Stock.	Admission Tickets.	Season Tickets.	Grand Stand.
New London Co.,..	$1,246.40	$942.50	$547.30	$1,138.10	$130.50	*$1,440.23	$13.55	$5,468.58	$4,000.00	$10,000.00	.....	229	....	.....	$0.35	$1.00	$0.25
Windham County,	700.00	405.00	115.00	1,207.30	269 63	72.20	.....	.....	.....	5,000.00	$500.00	630	....	.....	.35	.....	.20
Beacon Valley,....	373.81	73.40	7.50	254.40	.....	20.09	729.20	.....	47.94	.....	.....	78	....	.....	.....	1.00	.25
Berlin,.....	146.65	.....	30.44	281.75	.....	.....	273.44	732.28	.....	500.00	.....	.....	....	.....	.25	1.00	.10
Branford,.....	219.78	190.00	35.00	123 05	.....	106.50	181.15	855.48	.....	.....	.....	79	....	.....	.25	.....	.25
Bristol Park Co.,..	496.81	170.00	100.00	677.61	.....	100.15	.....	1,550.57	.....	.....	.....	275	....	.....	.25	.....	.10
Chester,.....	56.53	.....	20.20	164.90	.....	10.00	.....	.....	.....	.....	.....	112	....	.....	.10	.25	.....
Clinton,.....	184.00	.....	38.00	225.90	.....	.....	87.16	535.06	.....	.....	.....	91	....	.....	.10	.....	.....
Danbury,.....	11,183.96	2,495.00	1,245.20	4,775.44	2,570.90	1,200.00	2,958.22	26,428.72	.....	20,000.00	3,000.00	....	295	$12,000	.35	5.00	.25, .50
Farmington Valley	419.76	740.00	40.00	485.10	.....	†1,233.12	.....	.....	2,400.00	9,203.07	40.50	....	80	5,000	.25	.....	.20
Granby,.....	268.28	600.00	.....	137.40	95.80	381.07	.....	1,482.55	300.00	2,500.00	500.00	....	86	3,000	.25	.....	.....
Guilford,.....	104.25	.....	.....	255.55	.....	.....	1,001.24	.....	.....	75.00	.....	.....	....	.....	.15	.50	.....
Harwinton,.....	187.96	.....	.....	184.70	.....	.....	136.04	508.70	.....	.....	250.00	115	....	.....	.....	.....	.....
Madison,..... ..	103.89	5.00	.....	177.50	.....	.....	10.83	.....	64.45	.....	20.00	78	....	.....	.10	.....	.....
New Milford, ...	544.83	750.00	140.00	431.75	.....	100.00	428.97	2,395.55	2,000.00	3,000.00	200 00	....	....	7,500	.25	.....	.25
Newtown, ...	.....	885.00	250.00	539.15	133.92	1,446.44	6.22	3,260.73	1,000.00	.....	7,000.00	....	117	5,000	.25	5.00	.50, .25
Orange,...	487.71	.....	33.65	171.75	203.79	.....	459.86	1,356.76	.....	.....	203.79	130	....	.....	.25, .15	1.00	.....
Putnam Park Ass'n	1,686.32	1,809.25	588.80	640.85	1,324.64	1,466.99	18.35	7,535.20	6,300.00	18,000.00	.....	....	148	‡10,000	.35	1.00	.25
R'kville Fair Ass'n	927.54	1,610.00	900.08	600.70	113.74	499.45	189.05	4,840.56	750.00	4,000.00	.....	....	106	‖10,000	.35	1.00	.25
Simsbury, ...	114.85	650.00	15.00	213.20	.....	152.92	.....	.....	.....	.....	.....	....	....	.....	.25	.....	.....
Southington,.....	489.46	450.00	81.25	480.85	300.00	.....	.....	.....	.....	5,000.00	100.00	....	11	2,600	.25	1.00	.15
Stafford Springs...	1,211.16	1,322.50	955.00	1,325.77	500.00	.....	1,863.71	7,178.14	.....	11,000.00	350.00	....	104	§5,000	.35	1.00	.25
Suffield,.....	.....	840.00	200.00	213.50	150.00	202.20	18.22	1,623.92	1,500.00	5,000.00	50.00	....	360	3,300	.35	.....	.10
Uni'n (Monr'e,etc.)	669.80	325.00	.....	355.88	.....	90.06	136.97	1,577.71	1,245.00	1,300.00	.....	122	....	.....	.25	1.00	.10
Uni'n (Som'rs,etc.)	59.70	.....	34.48	263.95	.....	60.95	1,156.96	1,576.04	.....	.....	.....	.....	.....	.....	.....	.....	.....
Wethersfield,.....	63.87	.....	.....	108.00	.....	133.94	28.66	334.47	1,628.90	7,000.00	300.00	250	47	5,000	.15	.30	.....
W'lm't'c Fair As'n	1,115.69	1,362.50	680.00	144.25	.....	132.44	.....	.....	.....	.....	.....	44	221	.....	.35	1.00	.25
Windsor,...	195.10	.....	.....	151.90	.....	.....	.....	.....	.....	.....	.....	101	...	.....	.35, .15	1.00	.....
Wolcott,.....	140.47	.....	40.00	525.00	.....	.....	1,473.86	2,179.33	.....	.....	100.00	90	....	.....	.25, .10	1.00	.....
Woodstock,.....	394.13	100.00	122.00	550.74	98.48	245.00	16.71	1,527.06	800.00	8,000.00	.....	500	....	.....	.25	.....	.15
Conn. Hort. Soc.,..	1,094.46	.....	.....	313.75	85.00	¶1,560.00	.....	3,053.21	.....	.....	850.00	164	....	.....	.25, .10	.....	.....
Conn. Dairy Ass'n,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	....	.....	.....	.....	.....
Conn. Pom. Soc.,..	98.60	.....	.....	274.00	.....	.....	.....	.....	.....	.....	.....	....	....	.....	.....	.....	.....

* Paid on mortgage $1,000. † Paid on indebtedness $1,000. ‡ $9,742 paid in. ‖ $3,130 paid in. § Paid in $2,000. ¶ Loans.

ANALYSIS OF PREMIUMS AND GRATUITIES PAID.—FARM STOCK.

SOCIETIES.	Bulls.	Milch Cows.	Heifers.	Calves.	Working Oxen.	Steers.	Fat Cattle.	Draft Oxen.	Horses, except Speed.	Horses, Speed.	Sheep.	Swine.	Poultry.	All other Stock.	TOTAL.
New London County,	$54.00	$215.00	$68.25	$39.00	$59.50	$17.25	$15.00	.....	$179.75	$932.00	$209.00	$23.50	$72.10	.....	$1,884.35
Windham County,	57.50	84.00	86.10	22.50	40.00	43.00	5.00	$52.00	170.00	405.00	26.00	21.00	47.00	.....	1,159.10
Beacon Valley,	10.50	23.25	5.00	3.00	7.00	.....	3.50	14.00	15.00	73.40	5.00	4.00	10.50	.....	174.15
Berlin,	8.00	36.00	6.00	3.00	2.50	1.50	.....	.....	28.00	.....	6.50	4.50	32.75	.....	128 75
Branford,	.....	6.50	1.00	1.00	6.00	.....	.....	6.00	5.00	100.90	.....	.....	12.50	$1.00	229.00
Bristol Park Co.,	20.50	93.50	14.50	.....	92.01	.....	.....	.....	25.00	.....	32.50	10.00	115.50	4.68	418.19
Chester,	2.50	2.00	3.50	3.50	6.00	2.00	.....	.....	1.50	.....	.....	.....	1.20	1.80	24.00
Clinton,	3.50	7.00	4 00	6.25	8.50	9.50	2.00	15.00	9.50	.....	6.75	8.00	21.75	6.60	108.35
Danbury,	173.00	179.00	94.00	45.00	107.00	38.00	.....	.....	316.00	2,495.00	13.00	.....	368.00	1,611.00	5,439.00
Farmington Valley,	30.00	50.00	16 50	13.00	19.00	17.00	7.00	29.00	28.00	740.00	14.00	.....	100.90	.....	1,064 40
Granby,	9.00	34.00	8.50	1.00	13.50	16.50	.....	.....	15.00	600.00	.....	.....	17.50	5 50	720.00
Guilford,	10.00	8.00	5.00	3.00	25.00	8.00	5.00	.....	10.00	.....	5.00	.....	20.00	.....	109.00
Harwinton,	2.65	2.30	1.15	.50	20.00	.....	1.00	39.00	7.00	.....	1.00	.....	25.00	.....	.....
Madison,	1.00	3.50	5.00	3.50	6.00	2.00	3.00	3.00	13.00	.....	5.00	7.00	10.00	1.50	63.50
New Milford,	11.50	18.00	48.50	3.50	15.00	42.50	8.00	11.00	15.00	14.00	3.00	8.00	8.75	1.00	207.75
Newtown,	25.50	31.00	24.50	7.50	49.00	23.50	9.00	35.00	25.00	885.00	3.00	.....	53.50	.....	1,171.50
Orange,	.50	14.25	1.00	4.50	5.00	1.00	3 00	8.00	16.50	.....	3.75	2.00	14.50	4.50	78.50
Putnam Park Asso'n,	15.00	82.00	24.00	.....	.....	.....	.....	.....	69.70	1,809.25	13.00	.....	34.50	66.40	2,113.85
Rockville Fair Asso'n,	.....	80.00	.....	.....	.....	.....	.....	.....	40.00	1,610.00	.....	.....	206.00	.....	1,936.00
Simsbury,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	153.20
Southington,	22.50	40.00	11.50	5.50	28.00	11.50	5.50	36.00	23.00	450.00	9.00	.....	112.50	.....	755.00
Stafford Springs,	64.00	105.00	60.00	26.00	30.00	21.00	.....	37.00	55.00	1,322.50	10.00	6.00	438.32	28.00	2,202.82
Suffield,	5.00	40.00	7.00	3.00	.....	.....	.....	.....	.....	840.00	5.00	.....	50.00	.....	950.00
Union (Monroe, etc.),	12.00	10.50	3.75	2.50	32.00	21.50	9.00	.....	45.00	325.00	6.00	5.00	26.00	.....	498.25
Union (Somers, etc.),	7.50	31.00	.7.50	14.50	12.00	7.00	.....	.....	38.00	.....	10.00	8.00	42.50	21.00	199.00
Wethersfield,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Willimantic Fair Asso'n,	.....	.....	.....	.....	.....	.....	.....	.....	15.00	.....	.....	.....	.....	.....	.....
Windsor,	.....	8.50	8.00	1.50	9.50	.....	.....	.....	26.00	.....	.....	.....	8.50	.....	62.00
Wolcott,	43.50	47.25	22.00	18.75	15.00	11.00	3.00	41.00	36.00	.....	12.50	4.00	57.00	38.00	349.00
Woodstock,	18.00	67.20	56.40	18.00	28.80	19.80	.....	.....	81.60	100.00	16 20	8.40	32.25	.....	446.65
Conn. Horticultural Soc'y,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Conn. Dairy Association,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Conn. Pom. Society,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

ANALYSIS OF PREMIUMS AND GRATUITIES.—Continued. FARM PRODUCTS.

SOCIETIES.	Indian Corn.	Wheat.	Rye.	Barley.	Oats.	Beans.	Buckwheat.	Grass Seeds.	Potatoes.	Carrots.	Beets.	Parsnips.	Turnips.	Onions.	Other products.	Total amount for Grain and Root Crops.
New London County,	$2.00	.....	$0.75	$0.75	.....	$0.75	$0.75	.....	$7.75	$1.25	$3.00	$0.75	$1.50	$1.25	$24.50	$45.00
Windham County,	4.50	.....	1.50	.....	$1.00	1.00	1.00	$2.25	15.25	.....	.75	.....	1.00	3.75	14.50	45.50
Beacon Valley,	.75	$0.25	.25	.....	.....	.75	.25	.....	36.00	.75	.75	.....	.50	.75	2.00	43.00
Berlin,	6.75	.....	1.25	.....	2.25	2.00	.50	.....	12.50	2.00	3.25	1.25	3.50	3.25	24.00	62.50
Branford,	.....	.....	.....	.....	.....	1.25	.....	.....	8.25	.....	1.25	.....	.75	1.75	13.00	26.25
Bristol Park Co.,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	84.60
Chester,	9.40	.....	.80	.....	.....	2.35	.30	.....	7.65	1.70	2.35	.70	1.95	2.40	30.60	60.20
Clinton,	3.90	.....	.40	.....	.....	2.00	.....	.....	10.55	.25	1.00	.....	.....	.80	1.65	20.55
Danbury,	11.00	.....	.50	.....	1.00	8.00	.50	.....	44.50	4.50	4.00	1.00	6.25	14.25	99.00	194.00
Farmington Valley,	5.05	.....	.....	.....	.75	4.20	1.50	.....	26.70	3.80	4.80	1.20	3.40	6.40	3.65	61.45
Granby,	.75	.....	1.00	.....	.....	.....	.....	.....	2.00	.....	.....	.....	.....	.....	.....	3.75
Guilford,	15.00	.....	8.00	.....	.....	.....	.....	.....	18.00	.....	3.00	.....	.....	6.00	12.75	62.75
Harwinton,	1.50	.....	.80	.....	.30	2.50	.80	.....	14.25	.75	1.50	.....	1.00	1 50	7 25	32.15
Madison,	5.25	1.00	1.00	1.00	.....	7.50	.....	.....	7.00	1.00	5.00	.....	1.00	2.00	11.75	43.50
New Milford,	.....	.50	.75	.50	.75	.....	.75	.....	40.25	.75	3.00	.....	.....	2.00	17.00	66.25
Newtown,	7.25	.....	.50	.....	.....	.75	.....	.....	15.25	1.75	1.25	.75	3.25	2.00	33.25	66.00
Orange,	3.00	.....	.....	.....	.....	.....	.....	.....	.....	.....	.50	.....	.....	.75	6.25	10.50
Putnam Park Ass'n,	3.75	.....	.50	.....	.....	1.75	.50	.....	8.00	.50	.75	.....	.....	2.50	6.25	24.50
Rockville Fair Ass'n,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	132.00
Simsbury,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Southington,	2.75	.....	.75	.50	.....	2.50	.75	.25	32.50	1.50	1.00	.....	.50	3.75	24.25	71.00
Stafford Springs,	9.50	1.25	2.50	1.75	2.25	7.50	3.00	.....	44.00	1.25	1.25	.25	2.00	3.00	21.75	101.25
Suffield,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	40.00
Union (Monroe, etc.),	4.25	.75	.....	.....	.25	.....	.....	.....	14.50	.75	.....	1.00	2 50	6.25	4.50	34.75
Union (Somers, etc.),	1.50	.75	.....	.....	.75	.....	.75	.....	6.75	.75	.50	.....	.50	.75	15.00	28.00
Wethersfield,	5.00	.....	.....	.....	.....	3.25	.....	.....	12.50	3.25	2.00	3.25	3.25	10.50	24.50	67.30
Willimantic Fair Ass'n,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Windsor,	.75	.....	.....	.....	.....	.75	.....	.....	7.25	2.25	1.75	.25	.....	2.75	13.25	29.00
Wolcott,	18.75	.....	.50	.....	.....	.....	.50	.....	50.00	1.00	2.00	.75	2.25	2.50	17.25	95.50
Woodstock,	4.95	.....	.90	.....	.60	.30	.90	.....	7.35	.45	.60	.....	.75	2.85	22.05	41.70
Conn. Hort. Soc.,	.....	.....	.....	.....	.....	.....	.....	.....	1.50	.25	.25	.....	.25	1.50	13.00	16.75
Conn. Dairy Ass'n,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Conn. Pom. Soc.,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

ANALYSIS OF PREMIUMS AND GRATUITIES.—CONTINUED. FARM PRODUCTS.

SOCIETIES.	Fruits.	Flowers.	Other Cult. Crops.	Butter.	Cheese.	Honey and Wax.	Bread and Cake.	Sugar, Syrup, Preserved Fruit.	Total Farm Products	Agricultural Implements.	Mechanical Inventions.	Fine Arts and Fancy Articles.	Decorated Carts and Trains of Oxen.	Plowing at Exhibition.	Grange Exhibit.	Medals.	Diplomas.
New London County,	$17.80	$11.00	.....	$8 75	.....	$1.50	$4.75	$2.00	$90.80	$5.00	$89.75	$92.00	.....	.....	.....	.....	.....
Windham County,	83.50	35.60	.....	4.50	$6.50	1.00	23.90	15.75	170.75	.....	20.00	207.95	.....	.....	.....	.....	11
Beacon Valley,	13.25	7.00	.....	.25	.....	.....	1.00	.....	107.50	.....	.....	4.75	$16.00	.....	.....	.....	.....
Berlin,	40.25	5.00	.....	3.50	.....	.....	15.00	3.50	129.75	.....	.....	15.25	8.00	.....	.....	.....	9
Branford,	45.25	1.50	.....	1.00	2.50	.50	3.75	3.25	84.00	.....	.....	7.00	.....	.....	.....	.....	.....
Bristol Park Co.,	.....	.....	.....	.....	.....	.....	.....	.....	166.45	3.00	27.43	.....	.....	.....	.....	.....	.....
Chester,	22.30	3.40	.....	.70	.....	.50	2.70	16.75	106.75	.....	10.30	13.85	10.00	.....	.....	.....	.....
Clinton,	17.50	5.10	$9.15	.30	.....	.....	19.75	3.10	75.45	.....	9.80	21.30	11.00	.....	.....	.....	.....
Danbury,	263.00	94.00	.....	5.00	.....	23.00	84.00	55.00	718.00	.....	354.44	715.00	44.00	.....	.....	.....	41
Farmington Valley,	41.00	7.50	.....	2.00	.....	.....	6.95	11.75	130.65	.....	.....	20.05	10.00	.....	.....	.....	.....
Granby,	1.00	2.50	.....	2.50	.....	.....	2.00	3.00	14.75	.....	.....	.....	.....	.....	.....	.....	.....
Guilford,	23.00	.50	.....	2.00	.....	9.00	5.00	3.00	105.25	.....	.....	25.30	16.00	.....	.....	.....	.....
Harwinton,	10.25	2.80	.....	.55	.35	.....	9.05	1.55	56.70	.....	.....	4.40	24.00	.....	.....	.....	.....
Madison,	15.50	2.70	.....	.....	.....	1.00	3.90	4.70	71.30	.....	.....	23.76	15.00	.....	.....	.....	5
New Milford,	53.50	4.25	.....	.....	.50	2 00	9.00	8.00	143.50	.....	2.75	85 00	.....	.....	.....	.....	.....
Newtown,	37 75	8.50	.....	3.00	.50	6.00	24.50	13.75	160.00	.....	.....	82.65	10.00	.....	.....	.....	17
Orange,	26.00	1.75	.....	.....	.....	.....	.....	1.50	39.75	.....	.....	17.50	36.00	.....	.....	.....	.....
Putnam Park Ass'n,	7.25	14.00	.....	.....	.....	1.00	9.50	2.50	58.75	.....	18.75	13.50	58.75	.....	.....	.....	.....
Rockville Fair Ass'n.	57.00	16.50	.....	12.50	.....	.....	.....	.....	218.00	.....	.....	56.70	.....	.....	.....	.....	6
Simsbury,	.....	.....	.....	.....	.....	.....	.....	.....	60.00	.....	.....	.....	.....	.....	.....	.....	.....
Southington,	58.25	2.75	.....	2.00	1.00	.50	4.00	10.65	150.15	.....	.....	25.70	.....	.....	.....	.....	.....
Stafford Springs,	33.50	4.50	.....	4.50	.....	.....	8 75	23.00	175.50	.....	36.00	38.95	.....	.....	.....	.....	18
Suffield,	40.00	5.00	.....	.....	.....	.....	.25	1.00	86.25	.....	8.75	8.50	.....	.....	.....	.....	.....
Union (Monroe, etc.),	27.25	14.75	.....	1.50	.....	.....	13.50	.25	92.00	.....	31.75	46.63	12.25	.....	.....	.....	3
Union (Somers, etc.),	8.95	.....	.....	1.75	.....	.....	2.80	1.50	43.00	6.00	.....	15.95	.....	.....	.....	.....	.....
Wethersfield,	25.50	1.50	.....	.....	.....	.....	6.00	1.50	102.00	.....	.....	6.00	.....	.....	.....	.....	.....
Willimantic Fair Ass'n,	.....	.....	.....	.....	.....	.....	.....	.....	144.25	.....	.....	.....	.....	.....	.....	.....	.....
Windsor,	12.40	4.75	4.25	1.00	.....	.....	8.00	.....	59.40	.....	.....	30.50	.....	.....	.....	.....	.....
Wolcott,	30.00	.25	.....	1 00	.50	.....	7.75	3.25	138.25	.....	.....	6.75	16.00	.....	$15.00	.....	.....
Woodstock,	21.81	23.64	.....	7.80	2.40	.60	10.68	4.20	112 83	.....	.....	60.66	12.00	$18.60	.....	.....	.....
Conn. Hort. Soc.,	10.75	286.25	.....	.....	.....	.....	.....	.....	313.75	.....	.....	.....	.....	.....	.....	3	11
Conn. Dairy Ass'n.,	.....	.....	.....	270.00	.....	.....	.....	37.50	274.00	.....	.....	.....	.....	.....	.....	.....	.....
Conn. Pom. Soc.,	236.50	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

NUMBER OF ANIMALS EXHIBITED.

SOCIETIES.	Bulls.	Milch Cows.	Heifers.	Calves.	Working Oxen (pairs).	Draft Oxen (pairs).	Steers (pairs).	Fat Cattle.	Horses — except speed.	Horses — speed.	Sheep.	Swine.	Poultry (coops).	All other Stock.
New London County,	15	163	35	24	23	.....	16	10	57	.....	179	15	95	.....
Windham County,	33	60	69	18	20	14	25	4	41	.....	50	30	62	.....
Beaver Valley,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Berlin,	9	42	4	2	6	.....	1	.....	55	.....	15	41	81	.....
Branford,	.....	8	1	1	3	2	.....	.....	4	7	.....	.....	25	.....
Bristol Park Co.,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Chester,	3	2	4	4	5	.....	2	.....	1	.....	.....	.....	4	6
Clinton,	5	13	9	7	5	8	10	4	12	.....	16	19	58	20
Danbury,	39	91	40	31	36	.....	31	.....	61	88	10	.....	420	.....
Farmington Valley,	15	30	12	13	24	11	20	5	13	.....	25	.....	121	.....
Granby,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Guilford,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Harwinton,	5	4	5	1	44	11	.....	4	1	.....	.....	.....	.....	.....
Madison,	1	5	7	6	3	2	2	4	2	.....	5 Pens	8 Pens	13	.....
New Milford,	6	10	49	10	6	6	29	6	12	9	4	11	25	2
Newtown,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Orange,	2	22	5	12	6	3	1	3	18	.....	14	15	12	5
Putnam Park Ass'n,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Rockville Fair Ass'n,	.....	25	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	399 B.	.....
Simsbury,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Southington,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Stafford Springs,	21	50	37	16	18	28	18	.....	22	.....	11	12	.....	.....
Suffield,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Union (Monroe, etc.),	7	10	6	5	12	.....	10	5	20	21	8	2	21	.....
Union (Somers, etc.),	3	48	7	9	4	.....	4	.....	23	.....	12	12	58	10
Wethersfield,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Willimantic Fair Ass'n,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Windsor,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Wolcott,	28	70	15	17	15	14	14	3	33	.....	20	4	205	12
Woodstock,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Connecticut Hort. Society,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Conn. Dairy Ass'n,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Conn. Pom. Soc.,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

AGRICULTURAL FAIRS IN CONNECTICUT.—1899.

SOCIETIES.	PLACE.	DATE.	ATTENDANCE.						
			Monday.	Tuesday.	Wednesday.	Thursday	Friday.	Saturday.	Total.
New London County,	Norwich,	Sept. 4–6,	4,000	6,000	2,500	....	....	....	12,500
Windham County,	Brooklyn,	Sept. 19–21,	....	....	....	....	....	....	....
Beacon Valley,	Naugatuck,	Sept. 19–20,	....	....	....	1,500	2,000	....	3,500
Berlin,	Berlin,	Sept. 27,	....	1,100	1,400	....	....	....	2,500
Branford,	Branford,	Sept. 20,	....	....	3,000	....	....	....	3,000
Bristol Park Co.,	Bristol,	Sept. 26–27,	....	....	1,500	....	....	....	1,500
Chester,	Chester,	Sept. 27,	....	....	1,500	2,000	....	....	3,500
Clinton,	Clinton,	Oct. 4,	....	....	850	....	....	....	850
Danbury,	Danbury,	Oct. 2–7,	2,050	2,524	3,000	....	....	....	3,000
Farmington Valley,	Collinsville,	Sept. 6–7,	....	....	7,107	17,334	4,345	10,070	43,430
Granby,	Granby,	Sept. 27–28,	....	....	1,200	4,000	....	....	5,200
Guilford,	Guilford,	Sept. 22,	....	....	800	2,000	....	....	2,800
Harwinton,	Harwinton,	Oct. 3,	....	8,000	3,000	....	....	....	3,000
Madison,	Madison,	Oct. 5–6,	....	....	....	....	....	....	8,000
New Milford,	New Milford,	Sept. 12–14,	....	400	....	1,500	500	....	2,000
Newtown,	Newtown,	Sept. 26–28,	....	500	2,500	1,200	....	....	4,100
Orange,	Orange,	Sept. 14,	....	....	3,000	2,500	1,000	....	7,000
Putnam Park Ass'n,	Putnam,	Sept. 22–24,	....	1,407	....	....	....	....	3,000
Rockville Fair Ass'n.,	Rockville,	Sept. 19–21,	....	....	5,477	2,068	....	....	8,952
Simsbury,	Simsbury,	Sept. 19–20,	....	....	....	500	5,200	1,600	7,300
Southington,	Southington,	Sept. 19–20,	....	....	....	....	....	....	....
Stafford Springs,	Stafford,	....	....	1,500	1,500	....	2,000	....	3,500
Suffield,	Suffield,	Sept. 19–20,	....	....	9,000	4,500	....	....	15,000
Union (Monroe, etc.),	Huntington,	Sept. 19–20,	....	1,040	....	....	....	....	....
Union (Somers, etc.),	Ellington,	Sept. 27,	....	....	1,964	....	....	....	3,004
Wethersfield,	Wethersfield,	Sept. 26–28	....	200	300	300	....	....	800
Willimantic Fair Ass'n.,	Willimantic,	Sept. 26–28,	....	....	2,000	4,000	1,000	....	7,000
Windsor,	Windsor,	Sept. 13–14,	....	....	400	600	....	....	1,000
Wolcott,	Wolcott,	Oct. 11,	....	....	3,000	....	....	....	3,000
Woodstock,	Woodstock,	Sept. 4–6,	....	1,840	1,238	....	....	....	3,078
Conn. Hort. Soc.	Hartford,	*	....	....	....	....	....	....	1,062
Conn. Dairy Asso.,	Hartford,	Jan. 17–18,	....	....	....	....	....	....	....
Conn. Pom. Soc.,	Hartford,	†Feb. 14–15,	....	....	....	....	....	....	....

* March, June, July, Sept., Nov. † Annual meeting.

OFFICIAL DIRECTORY

OF THE

CONNECTICUT PATRONS OF HUSBANDRY,

FOR 1900.

OFFICERS OF CONNECTICUT STATE GRANGE.

Master, B. C. PATTERSON, Torrington.
Overseer, IVERSON C. FANTON, Westport.
Lecturer, FRANK S. HOPSON, Station 3, Bridgeport.
Steward, J. B. BLIVEN, North Franklin.
Asst. Steward, ROBERT W. ANDREWS, New Britain.
Chaplain, REV. C. H. SMITH, Plymouth.
Treasurer, NORMAN S. PLATT, New Haven.
Secretary, HENRY E. LOOMIS, Glastonbury.
Gate-Keeper, E. H. WRIGHT, Clinton.
Ceres, MISS GERTRUDE U. BRADLEY, Waterbury.
Pomona, MRS. SABRA M. KELSEY, Higganum.
Flora, MRS. MAUDE K. WHEELER, Storrs.
Lady Steward, MRS. ALICE L. POTTER, North Woodstock.

EXECUTIVE COMMITTEE.

H. F. POTTER, Montowese,	Term Expires,	1901.
ORSON S. WOOD, Ellington,	" "	1902.
J. H. HALE, South Glastonbury,	" "	1903.
B. C. PATTERSON, *ex officio*,	" "	1902.
H. L. LOOMIS, *ex officio*,	" "	1902.

FINANCE COMMITTEE.

H. C. DUNHAM, Middletown, R. R. WOLCOTT, Wethersfield.
GEORGE A. HOPSON, East Wallingford.

OFFICERS OF THE GRANGES.

NAME.	MASTER.	LECTURER.	SECRETARY.
POMONA GRANGES.			
Central Pomona, No. 1,	E. F. Gaylord, Bristol,	Robert W. Andrews, New Britain,	Chas. E. Bacon, Middletown.
Quinebaug Pomona, 2,	Jonathan Anthony, Scotland,	Mrs. Lisa K. Fuller, Scotland,	L. H. Healy, N. Woodstock.
East Central Pomona, 3,	J. E. Collins, Wapping,	O. S. Wood, Ellington,	Mrs. Laura J. Brewer, Hillstown.
Mountain County Pomona, 4,	Geo. S. Hammond, W. Goshen,	Ard Welton, Plymouth,	N. S. Stevens, East Canaan.
New Haven Co. Pomona, 5,	H. C. C. Miles, Milford,	Mrs. C. A. D. Allen, Wallingford,	Mrs. L. P. Tuttle, North Haven.
New London Co. Pomona, 6,	J. B. Bliven, North Franklin,	E. J. Hempstead, New London,	H. W. Morse, Jewett City.
Excelsior Pomona, 7,	D. M. Somers, Woodbury,	M. F. Skelley, Woodbury,	Mrs. Sarah S. Talmadge, Prospect.
Seaview Pomona, 8,	Samuel A. Chalker, Saybrook,	Mrs. Mary J. Brooks, Clinton,	Cyrus D. Evarts, Killingworth.
Fairfield County Pomona, 9,	D. A. St. John, New Canaan,	G. M. Wakelee, Shelton,	Vanderbilt Godfrey, Norwalk.
SUBORDINATE GRANGES.			
Granby, No. 5,	Frederick J. Jewett, North Granby,	Mrs. Ellen S. White, No. Granby,	Lydia C. Loveland, No. Granby.
Washington, 11,	Frank L. Hallock, Washington Depot,	Mrs. E. C. Whitehead, Wash. Depot,	Mrs. C. C. Ford, Washington Depot.
East Granby, 12,	C. H. Hanchett, East Granby,	Edward Knechler, Suffield,	Mrs. Mary Lobdell, East Granby.
Tunxis, 13,	T. E. Griswold, Bloomfield,	F. L. Granger, Jr., Bloomfield,	A. C. Case, Bloomfield.
Hope, 20,	K. K. Kimberly, West Torrington,	Mrs. Martha Ives, West Torrington,	Sherman Kimberly, W. Torrington.
Lebanon, 21,	Fred N. Taylor, Lebanon,	Rev. L. E. Livermore, Lebanon,	N. S. Loomis, Lebanon.
Advance, 22,	J. C. Eddy, Simsbury,	George Patterson, Simsbury,	Mrs. Hattie H. Eno, Simsbury.
Cheshire, 23,	Walter H. Baldwin, Cheshire,	Mrs. Carrie L. Peck, West Cheshire,	G. A. Hitchcock, Cheshire.
Berlin, 24,	Earl Cooley, Berlin,	Dr. W. W. Christian, Berlin,	Jas. E. Beale, Berlin.
Union, 25,	John C. Frisbie, Southington,	Martin M. Frisbie, Southington,	Mrs. E. H. Barnes, Southington.
Glastonbury, 26,	Geo. H. Carrier, Glastonbury,	Mrs. J. H. Hale, South Glastonbury,	Mrs. Emma Hale, So. Glastonbury.
Suffield, 27,	Frank H. Sikes, Mapleton,	Arthur A. Sikes, Mapleton,	Edwin F. Newton, Mapleton.
Meriden, 29,	Julius H. Yale, Meriden,	Mrs. M. A. Francis, Meriden,	J. H. Francis, Meriden.
Wapping, 30,	Alfred Miner, Vinton's Mills,	Walter N. Foster, Wapping,	Mrs. Sarah J. Collins, Wapping.
Manchester, 31,	A. W. Hollister, South Manchester,	Miss Mary Strong, So. Manchester,	K. B. Loomis, South Manchester.
North Cornwall, 32,	Hubert M. Pratt, West Cornwall,	Miss Adele T. Peck, West Cornwall,	Mrs. Niles Scoville, West Cornwall.
Wallingford, 33,	Zera P. Beach, Wallingford,	F. Seth Wiard, Yalesville,	Geo. H. Bronson, Northford.
Cawasa, 34,	Herbert H. Barnes, Collinsville,	John Crowley, Canton Center,	A. W. Bristol, Jr., Canton Center.
North Haven, 35,	Charles N. Turner, Montowese,	Mrs. C. N. Turner, Montowese,	Charles H. Thorpe, North Haven.
Little River, 36,	Fred Litchfield, Hampton,	Mrs. Angie Burnham, Hampton,	Mrs. Gertie Thompson, Hampton.
East Hartford, 37,	Lewis T. Judson, Silver Lane,	C. R. Risley, Silver Lane,	Mrs. L. M. Judson, Silver Lane.
New Canaan, 38,	J. E. Selleck, New Canaan,	Rev. J. H. Hoyt, New Canaan,	Mrs. Estella St. John, New Canaan.
Burritt, 39,	Arthur C. Blake, New Britain,	Robt. W. Andrews, New Britain,	Mrs. F. H. Sharpe, New Britain.
Senexet, 40,	Byron H. Evans, South Woodstock.	Dr. G. Austin Bowen, So. Woodstock,	E. P. Berrian, South Woodstock.
Mattabessett, 42.	E. J. Roberts, Middletown,	Mrs. Sarah Hubbard, Middletown,	Miss Fannie W. Prior, Middletown.
Brooklyn, 43,	C. S. Hyde, Brooklyn,	N. G. Williams, Brooklyn,	H. D. Crosby, Brooklyn.

Newington,	44,	DeForest E. Turner, Newington,	Mrs. Emeline E. Jacobs, Newington,	Mrs. Nellie Luce Eddy, Newington.
Ellington,	46,	Orson S. Wood, Ellington,	Mason P. Ellsworth, Windsorville,	George Knowles, Ellington.
Bolton,	47,	C. N. Loomis, Bolton,	Mrs. C. N. Loomis, Bolton,	Miss Maud White, Bolton.
Whigville,	48,	E. F. Gaylord, Bristol,	A. W. Barker, Whigville,	J. D. Slocum, Unionville,
Westfield,	50,	F. E. Boardman, Little River,	Rev. D. B. Hubbard, Little River,	Mrs. A. L. Congdon, Middletown.
Tolland,	51,	James H. Clough, Tolland,	Mrs. Abbie F. Hurlbut, Rockville,	Chas. S. Hurlbut, Rockville.
Vernon,	52,	Charles B. Reed, Rockville,	Mrs. Alice M. Dart, Rockville,	Mrs. E. D. Pitkin, Talcottville.
Poquonock,	53,	Eli S. Hough, Poquonock,	A. H. Clark, Poquonock,	Mrs. Alice J. Alford, Poquonock.
Plainville,	54,	Edgar Taylor, Plainville,	Miss Jessie Goodrich, Plainville,	Mrs. E. M. Baker, Plainville.
Stafford,	55,	J. M. Larned, Stafford Springs,	Mrs. J. C. Crawford, Staffordville,	Miss Mabel E. Edson, Stafford.
East Haddam,	56,	Wm. I. Gelston, Little Haddam,	Mrs. M. T. Bingham, Little Haddam,	Samuel E. Williams, Moodus.
Durham,	57,	C. W. Coe, Durham Center,	Miss Lena Sage, Durham Center,	F. P. Brainard, Durham Center.
West Hartford,	58,	D. G. Francis, West Hartford,	Mrs. S. P. Griswold, West Hartford,	F. H. Stadtmueller, Elmwood.
Saybrook,	59,	John S. Dickinson, Saybrook,	Mrs. Ida H. McAllister, Saybrook,	Mrs. Mary J. Parsons, Saybrook.
Crystal Lake,	60,	Arthur M. Keith, Eastford,	Mrs. Lucy George, Eastford,	Monroe F. Latham, Phœnixville.
Wolf Den,	61,	Joseph H. Elliott, Elliott,	Howard P. Wheeler, Abington,	Mrs. E. S. Estabrook, Pomfret.
Eureka,	62,	Gustavus C. Beckwith, Nepaug,	Mrs. Chloe J. Beaney, New Hartford,	Mrs. M. V. Douglass, Collinsville.
Middlefield,	63,	Alfred H. Augur, Middlefield,	Miss Grace E. Miller, Middlefield,	Miss Clara E. Smith, Middlefield.
Mansfield,	64,	B. F. Koons, Storrs,	N. S. Mayo, Storrs,	H. A. Ballou, Storrs.
Quinnatisset,	65,	Mrs. Abbie S. Moriarty, Wilsonville,	Josephine Law, Thompson,	Mrs. Alice Elliott, Thompson.
Killingworth,	66,	Lovel D. Parmelee, Killingworth,	Nathan H. Evarts, Killingworth,	Miss Minnie E. Coe, Killingworth.
Cromwell,	67,	Geo. S. Butler, Cromwell,	Caleb S. Pease, Cromwell,	Miss Hattie M. Hubbard, Cromwell.
Shetucket,	69,	Jonathan Anthony, Scotland,	Miss Mary A. Smith, Scotland,	Miss Edna L. Clark, Scotland.
Canterbury,	70,	E. E. Barrows, South Canterbury,	Miss L. E. Whitford, So. Canterbury,	Levi N. Clark, So. Canterbury.
Mad River,	71,	C. F. Hoggett, Waterbury,	Mrs. H. Hitchcock, Waterbury,	Mrs. A. E. Hall, Waterbury.
Plymouth,	72,	Frederick L. Tolles, Plymouth,	Miss Carrie Ploucquet, Plymouth,	Geo. F. Hare, Terryville.
Indian River,	73,	Ernest T. Beard, Milford,	S. E. Frisbie, Milford,	H. C. C. Miles, Milford.
Winchester,	74,	W. L. Wetmore, Winchester,	Mrs. Horace Burr, Winchester,	Miss F. L. Wetmore, Winchester.
Coventry,	75,	Andrew Kingsbury, Coventry,	Miss Fannie J. Kingsbury, Coventry,	Mrs. L. J. Loomis, Coventry.
Andover,	76,	E. M. Yeomans, Andover,	Mrs. J. A. James, Andover,	J. M. Copley, Andover.
Clinton,	77,	Hosmer A. Tryon, Clinton,	Mrs. Mary J. Brooks, Clinton,	Clifford H. Evarts, Clinton.
Colchester,	78,	Carroll E. Staples, Colchester,	Mrs. Maria Hall, Colchester,	Mrs. Hattie J. Strong, Colchester.
Housatonic,	79,	Frank S. Hopson, Sta. 3, Bridgeport,	Miss Eva Innis, Stratford,	George Meachen, Stratford.
Colebrook,	82,	Lester N. Smith, Mill Brook,	Mrs. Emma B. Leonard, Colebrook,	Mrs. Eleanor C. Turner, Colebrook.
Foxon,	84,	A. F. Sperry, New Haven,	C. W. Granniss, New Haven,	Frank M. Sperry, New Haven.
Wangumbaug,	85,	E. F. Hutchinson, South Coventry,	Mrs. May L. Williams, So. Coventry,	Mrs. Ella S. Loomis, S. Coventry.
Webutuck,	86,	Jas. S. Chaffee, Amenia Union, N. Y.,	Mrs. T. S. Clark, Amenia Union, N.Y.,	H. V. D. Reed, Amenia Union, N. Y.
Hillstown,	87,	F. N. Buckland, Hillstown,	Mrs. Laura J. Brewer, Hillstown,	James W. Bancroft, Hillstown.
Ekonk,	89,	Alfred Gallup, Ekonk,	Mrs. Ada Greene, Ekonk,	John E. Tanner, Campbell's Mills.
Ashford,	90,	Wilbur Lanphear, Ashford,	Rev. Austin Gardner, Ashford,	Bert H. Gardner, Warrenville.
Harmony,	92,	Ambrose S. Hurd, Monroe,	John M. Burr, Stepney Depot,	Edwin C. Shelton, Monroe.
Border,	93,	Geo. H. Andrews, Willimantic,	Wm. Hillhouse, Willimantic,	B. H. Tiffany, Willimantic.
East Windsor,	94,	L. Stoughton, Jr., E. Windsor Hill,	Mrs. Kate Bissell, East Windsor,	Mrs. Ellen M. Clapp, East Windsor.
Jewett City,	96,	H. M. Miner, Jewett City,	W. A. Edmond, Griswold,	C. C. Palmer, Jewett City.
Putnam,	97,	Amos B. Carpenter, Putnam,	Elmer C. Wood, Attawaugan,	Edwin L. Wood, Putnam.

OFFICERS OF THE GRANGES.—Continued.

Name.		Master.	Lecturer.	Secretary.
Subordinate Granges.— *Cont.*				
Barkhamsted,	98,	Wallace Case, Barkhamsted,	Mrs. Burton Tiffany, Barkhamsted,	F. B. Tiffany, Barkhamsted.
Hamden,	99,	Willis M. Cook, Mt. Carmel Center,	Miss A. M. Bradley, Mt. Carmel Cntr.,	Oscar L. Smith, New Haven.
Taghhannuck,	100,	E. R. Chapman, Wassaic, N. Y.,	Mrs. Alida C. Buckley, Ellsworth,	Rev. G. F. Goodenough, Ellsworth.
Mashapaug Lake,	101,	Robert E. Webster, Union,	Mrs. Josie B. Towne, Union,	George E. Reed, Union.
Beacon Valley,	103,	F. S. Truesdell, Naugatuck,	Mrs. Belle Fowler, Naugatuck,	E. A. Hotchkiss, Naugatuck.
Somers,	105,	Merritt A. Davis, Somers,	Mrs. Bertha F. Avery, Somers,	Erwin D. Avery, Somers.
East Haven,	106,	R. H. Coe, East Haven,	Charles J. Curtiss, East Haven,	S. U. F. Andrews, East Haven.
Litchfield,	107,	Fred L. Tharp, Litchfield,	J. H. Putnam, Litchfield,	Fred B. Plumb, Litchfield.
Woodbridge,	108,	Edw. A. Hitchcock, Westville,	Charles A. Bond, Westville,	Charles P. Augur, Westville.
East Hampton,	109,	E. W. Day, East Hampton,	Charles A. Hall, East Hampton,	John R. Rich, East Hampton.
Killingly,	112,	Chas. H. Pellett, Danielson,	Miss C. Ella Day, Danielson,	Walter F. Day, Danielson.
Highland,	113,	J. B. Tillinghast, So. Killingly,	Mrs. Ida M. Tillinghast, Highland,	Mrs. Emily P. McEwen, Moosup.
Wethersfield,	114,	Wilfred E. Griswold, Wethersfield,	Mrs. Frank G. Carpenter, Wethersfield,	Dudley Welles, 2d, Wethersfield.
Rocky Hill,	115,	L. B. Williams, Rocky Hill,	Mrs. Jane E. Blinn, Rocky Hill,	William Warner, Rocky Hill.
Bristol,	116,	Burdett A. Peck, Bristol,	Elbert W. Gaylord, Bristol,	George W. Case, Bristol.
Unity,	117,	Geo. W. Spicer, Deep River,	Miss Helen L. Post, Deep River,	Mrs. Flora M. Dudley, Deep River.
Beacon,	118,	Elbert A. Hopkins, Northfield,	F. Louis Grant, Northfield,	Mrs. Allie L. Nearing, Northfield.
Morris,	119,	Frederick F. Wadhams, Morris,	Jessie E. Humphrey, Morris,	Geo. E. Alvord, Morris.
Madison,	120,	D. Eugene Smith, Madison,	Joseph D. Kelsey, Madison,	Miss Jennie M. Whedon, Madison.
Bethlehem,	121,	James W. Flynn, Bethlehem,	Mrs. Dora H. Bloss, Bethlehem,	Mrs. Stella Flynn, Bethlehem.
Watertown,	122,	Orrin D. Estey, Watertown,	Alfred N. Matson, Oakville,	Miss Ada M. Skilton, Watertown.
Westbrook,	123,	David C. Dibble, Westbrook,	Horace E. Kelsey, Westbrook,	Daniel W. Grosvenor, Westbrook.
Higganum,	124,	Myron G. Skinner, Higganum,	Leroy A. Smith, Higganum,	Robt. H. Freeman, Higganum.
Hollenbeck,	125,	Nelson J. Dean, Huntsville.	Miles L. Blodget, Huntsville,	Mrs. Lois Pendleton, South Canaan.
Pleasant Valley,	126,	E. M. Barnes, North Woodbury,	M. F. Skelley, No. Woodbury,	Miss Mattie E. Barnes, No. Woodbury.
Goodwill,	127,	Chas. J. Goodale, Glastonbury,	Mrs. Chas. J. Goodale, Glastonbury,	Harold B. Waldo, Naubuc.
Orange,	128,	Bela M. Alling, Tyler City,	Mrs. Bela M. Alling, Tyler City,	Miss Josephine T. Clark, Orange.
Pohtatuck,	129,	K. L. Coleman, Newtown,	John J. Northrup, Newtown,	C. B. Johnson, Newtown.
Farmill River,	130,	Nicholas Wakelee, Shelton,	Percy Card, Shelton,	T. F. S. Bartlett, Shelton.
Columbia,	131,	Herbert P. Collins, Columbia,	Miss Lulu Estella Hills, Columbia,	Miss Amelia J. Fuller, Columbia.
Wichita,	132,	Austin R. Humphrey, Warren,	Mrs. Belle Johnson, Warren,	Max Schnell, Warren.
Greenfield Hill,	133,	Andrew B Wakeman, Greenfield Hill,	Simeon Pease, Greenfield Hill,	Mrs. D. B. Adams, Greenfield Hill.
Trumbull,	134,	Albert E. Linsley, Trumbull,	Joseph M. Tucker, Trumbull,	Wm. H. Brinsmade, Nichols.
Silver Lake,	135,	Joseph J. Ryan, Sharon,	Miss Mary Merwin, Sharon,	Kate B. Whitford, Sharon.
East Canaan,	136,	Geo. K. Goodwin, East Canaan,	Miss Mary E. Stevens, East Canaan,	Mrs. Lillian Stevens, East Canaan.
Willington,	137,	F. W. Pratt, W. Willington,	Mrs. C. H. Brown, Willington,	A. H. Eldredge, Willington.
Middlebury,	139,	Dwight L. Wheeler, Middlebury,	Fred L. Bassette, Middlebury,	A. S. Clark, Middlebury.

Plainfield,	140,	Arthur H. Mathewson, Plainfield,	Mrs. Annie E. Bulkley, Plainfield,	David C. Kinne, Plainfield.
Brookfield,	141,	S. B. Terrill, Brookfield,	Mrs. S. B. Terrill, Brookfield,	M. J. Beehler, Brookfield.
Rock Rimmon,	142,	H. C. Baldwin, Beacon Falls,	C. D. Roberts, Beacon Falls,	Miss Jessie Carrington, Seymour.
Goshen,	143,	Morris A. Tuttle, West Goshen,	Miss Bertha Williams, West Goshen,	Miss Flora E. Wright, West Goshen.
Prospect,	144,	John R. Platt, Prospect,	Mrs. Nettie Clark, Prospect,	Mrs. Sarah S. Talmadge, Prospect.
Rippowam,	145,	Cyrus Sarles, High Ridge,	Mrs. Sarah Sarles, High Ridge,	Miss Lucy R. Walker, Long Ridge.
Norfield,	146,	J. C. Jackson, Norwalk,	Frank P. Lane, Norwalk,	Harry R. Jackson, Norwalk.
Lyme,	147,	Stephen P. Sterling, Hamburg,	Mrs. Lizzie M. Bill, Hamburg,	Lodowick Bill, Hamburg.
Westport,	148,	Wm. J. Wood, Westport,	Mrs. Annie M. Wood, Westport,	Miss B. I. Wakeman, Green's Farms.
Easton,	149,	Geo. S. Gillette, Adams,	Mrs. Ellie E. Gillette, Adams,	Geo. B. Beers, Plattsville.
Woodstock,	150,	David Aldrich, North Woodstock,	Thomas Bradshaw, North Woodstock,	Miss M. F. Potter, North Woodstock.
Enfield,	151,	Frank W. Parsons, Hazardville,	Samuel H. Neelans, Melrose,	Henry F. Fletcher, Scitico.
Cannon,	152,	Wm. E. Hooker, Wilton,	Miss Josephine Osborn, Cannon,	Samuel Osborn, Cannon.

ANCIENT OR REMARKABLE TREES.

In response to a request for descriptions and photographs of remarkable or historic trees in Connecticut I have collected a few. From the promises I have received I am confirmed in my opinion that almost every neighborhood has some such specimens worthy of commemoration. But as I cannot longer delay the press I give what I have.

The Charter Oak is the most famous tree that we have had in Connecticut. It was an old tree when Hartford was settled. The hiding of the charter in its hollow trunk to preserve it from the demand of Sir Edmund Andros by Wadsworth and his assistants in 1687 have rendered it historic.

It was blown down in an August gale in 1856. It was a lusty tree, with a low, spreading top, and trunk circumference of twenty-one feet. Copy of painting from life by Henry Bryant, courtesy for this and Ledyard Elm of the *Connecticut Monthly*.

The Ledyard Elm was planted by John Ledyard, the famous African traveler, about 1770.

He came down the Connecticut in a canoe hollowed from a single log about fifty feet long, and found harbor in Little River. Here he planted this tree on the northern bank, and in all transfers of its site its preservation was secured, as it was not to be cut during its natural life. It stood in the highway in Arch Street near the Lincoln Iron Works. It was a vigorous, sturdy tree, but died and was cut down by the city in December, 1896. The trunk was short, about ten feet in circumference, with large branches a foot or more in diameter. A section of one branch is preserved in the rooms of the Connecticut Historical Society, the gift of Charles A. Lincoln.

Locust Trees at Cornwall Center. The oldest inhabitant remembers this cluster of locusts as large trees in his boyhood.

They are now about one hundred and ten feet high, and trunk circumference of ten feet. One has been cut in recent years. They stand on the sidehill overlooking the present village of Cornwall, on the border of a plot of ground laid out by the original proprietors as a public green. There is no definite knowledge as to who was the planter. As they stand in front of the residence of the late Rev. Hezekiah Gold, who was ordained as pastor of the Congregational Church in Cornwall in 1755, it is admitted that they were probably planted by him, as he was also a successful farmer. The clergy of those days were much interested in Horticulture, as well as general agriculture. They disseminated choice fruits, as many old parsonage orchards still witness.

A Primeval White Oak, Cornwall. This white oak tells its own story. It was an old tree at the time of the first survey of Cornwall, about 1740, and as a bounds tree bears many surveyors' marks on its bark. The wood around it has been repeatedly cut for charcoal, leaving it exposed to racking winds on the mountain side about a mile from the Housatonic River. Knarled and twisted, with hollow trunk, it is a remnant of the primeval forest which covered the State when Indians were the sole occupants. It is far surpassed in size by trees in more favored localities. No other living things have seen as much history as these old "first settlers" of the forest.

Queen Margaret's Elm, Sharon. Mr. Myron B. Benton of Leedsville, N. Y., says: "This tree stands on the farm of Mr. Robert E. Randall, adjoining my own, and is in Connecticut, a few rods from the State line. The tree is in a very vigorous and luxuriant condition, as is generally the case with elms upon dry land, never permanently moist land. It has a great breadth in proportion to its height, the spread being a little over 100 feet. The circumference of the trunk at the smallest, between the roots and branches, is thirteen feet four inches. The wide spread of the roots above ground at the base of the trunk is very striking. It is one of the handsomest elms that I know." As for the name he says:

"Many of my readers will remember the vivacious and exceedingly witty but sadly distraught Sophronia Gordon who 'wandered like the breeze' in former days through all this region. Her exuberent fancy gave the poetical name of 'Queen Margaret's Elm' to the wide-spreading umbrageous tree; and she used to take the luncheons which the kindly Mrs. Morehouse gave her, and to eat them under the royal shade." I have the illustration by courtesy of the *Connecticut Monthly*.

Wayside Elm, Wilton. This tree stands in the highway at Belden Hill on the road to Norwalk, opposite the residence of Arthur N. Benedict. The ladder is for the convenience of those wishing to sit on the seats erected between the limbs. Circumference of body one foot from the ground is twenty feet three inches; two feet, seventeen feet six inches. It overhangs a circumference of three hundred and sixty-seven feet, being one hundred and seventeen feet from tip to tip in opposite directions. Its longest limb reaches from the body sixty-two feet. The trunk is ten feet without a limb. It shows no signs of decay, and the elm tree beetle, though attacking smaller trees in the vicinity, has respected this. Rival traditions fail to establish the age of this tree or the name of the planter, though they are very definite and positive. We are indebted to Mr. D. H. Van Hoosear of Wilton for photograph and description of this beautiful tree.

Elm in West Hartland near the Barkhamsted line, on land of James Pierce. Set out by the great-great-grandfather of Frank B. Tiffany of Barkhamsted, about 150 years ago. It now measures twenty-one feet in circumference and covers thirty-six square rods with its branches. I have no illustration.

White Oak near residence of Simon Hunt, Columbia. This was a sizable tree in 1770; still vigorous. It is fifteen feet in circumference four feet from the ground. Its limbs spread ninety feet. Used to shade carts in hot weather.

Widger's Oak, Essex. Planted at the foot of "Old Widger's" grave by those who buried him. He was one of

the last of the aborigines, and lived in a cabin near by. Near this is a hill called "Widger Hill," where there is a fine view of Long Island. The tree is now in perfect condition, and stands on the farm of Richard Post, one-third of a mile from the highway. This is a white oak two and one-half feet in diameter, and was planted about one hundred and twenty years ago. Another one, a yellow oak, was planted seven feet due north, at the head of the grave, and was cut for ship timber some twenty years ago. Russell Post, who as a little boy saw the ceremony, died twenty-four years ago at the age of ninety-eight years.

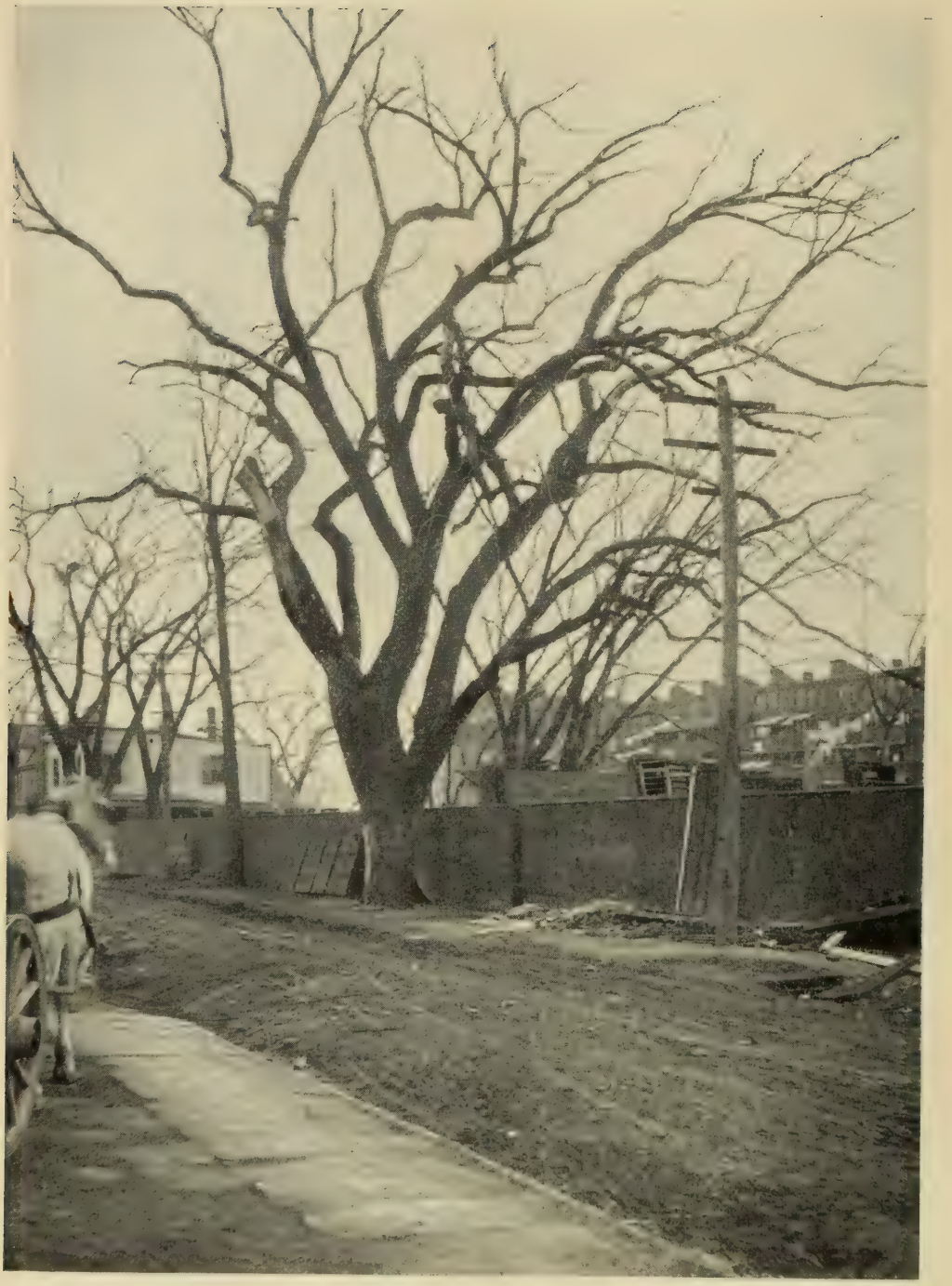
Hickory Nuts. This page of hickory nuts illustrates in exact size different varieties found in the State. The first is from F. B. Chapman, East Hampton; second, H. S. Kirtland, Yalesville; third, Chas. E. Hull, Seymour; fourth, D. H. Van Hoosear, Wilton. The shell of the first — the Chapman — is thick, but it has a full, good meat. The others are all thin shelled, full meated, and of excellent flavor. They are each pronounced "the very best." The soil and climate of Connecticut are well adapted to the hickory, and there is no reason why the growing of choice varieties for market should not become a profitable industry.

The Chapman Hickory, East Hampton, is about eight inches in diameter. The trunk appears in a separate cut for near view, and from its smoothness shows that it is hardly a shagbark. A study of the foliage, flowers, and fruit another season will determine its species.

The Van Hoosear Hickory, Wilton. Circumference one foot from the ground, four feet six inches. Height, forty-eight feet. Age, about thirty years.



No. 1.—THE CHARTER OAK.



No. 2.— THE LEDYARD ELM.



No. 3.— LOCUST, CORNWALL.



No. 4.— WHITE OAK, CORNWALL.



No. 5.—QUEEN MARGARET'S ELM.



No. 7.—WHITE OAK, COLUMBIA.



No. 6.— WAYSIDE ELM, WILTON.



No. 8.—WIDGER'S OAK, ESSEX.



No. 9.— HICKORY NUTS.



No. 10.— HICKORY, F. B. CHAPMAN, EAST HAMPTON.



No. 11.— HICKORY TRUNK, F. B. CHAPMAN.



No. 12.— HICKORY, D. H. VAN HOOSEAR, WILTON.

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STATE OF CONNECTICUT

TWENTY-THIRD ANNUAL REPORT

OF

The Connecticut Agricultural Experiment Station

For 1899.

Printed by Order of the General Assembly

The publications of this Station are sent free to every citizen of Connecticut who applies for them. Address, The Conn. Agricultural Experiment Station, New Haven, Conn.

NEW HAVEN, CONN.:
THE TUTTLE, MOREHOUSE & TAYLOR COMPANY
1900

CONNECTICUT AGRICULTURAL EXPERIMENT STATION.

OFFICERS AND STAFF FOR 1899.

STATE BOARD OF CONTROL.

Ex officio.

HIS EXCELLENCY GEORGE E. LOUNSBURY, *President.*

	Term expires.
Appointed by Connecticut State Agricultural Society :	
S. M. WELLS, Wethersfield.	July 1, 1900
Appointed by Board of Trustees of Wesleyan University :	
PROF. W. O. ATWATER, Middletown.	1900
Appointed by Governor and Senate :	
EDWIN HOYT, New Canaan.	1901
JAMES H. WEBB, Hamden.	1902
Appointed by Board of Agriculture :	
T. S. GOLD, West Cornwall, *Vice-President.*	1901
Appointed by Governing Board of Sheffield Scientific School :	
W. H. BREWER, New Haven, *Secretary and Treasurer.*	1902
Ex officio.	
S. W. JOHNSON, New Haven, *Director.*	

Executive Committee.

STATION STAFF.

Chemists.

S. W. JOHNSON, *Director.*
E. H. JENKINS, PH.D., *Vice-Dir.*
A. L. WINTON, PH.B.
W. L. MITCHELL, PH.B.*
T. B. OSBORNE, PH.D.
A. W. OGDEN, PH.B.
G. F. CAMPBELL, PH.B.
CLIFFORD LANGLEY, PH.B.†

Botanist.

WILLIAM C. STURGIS, PH.D.

Horticulturist.

W. E. BRITTON, B.S.

Grass Gardener.

JAMES B. OLCOTT, South Manchester.

Stenographer and Clerk.

MISS V. E. COLE.

In charge of Buildings and Grounds.

CHARLES J. RICE.

Laboratory Helpers.

HUGO LANGE.
WILLIAM POKROB.

Sampling Agent.

V. L. CHURCHILL, New Haven.

* Till Sept. 1st, 1899.

†From Sept. 1st, 1899.

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ANNOUNCEMENT.

THE CONNECTICUT AGRICULTURAL EXPERIMENT STATION was established in accordance with an Act of the General Assembly approved March 21, 1877, "for the purpose of promoting Agriculture by scientific investigation and experiment."

The Station is prepared to analyze and test fertilizers, cattle-foods, seeds, milk, and other agricultural materials and products, to identify grasses, weeds, moulds, blights, mildews, useful or injurious insects, etc., and to give information on various subjects of Agricultural Science, for the use and advantage of the citizens of Connecticut.

The Station does not undertake sanitary analyses of water.

The Station makes analyses of Fertilizers, Seed-Tests, etc., for the citizens of Connecticut, without charge, provided—

1. That the results are of use to the public and are free to publish.

2. That the samples are taken from stock now in the market, and in accordance with the Station "Instructions for Sampling."

3. That the samples are fully described and retail prices given on the Station "Forms for Description."

The officers of the Station will take pains to obtain for analysis samples of all the commercial fertilizers sold in Connecticut; but the organized coöperation of farmers is essential for the full and timely protection of their interests. Granges, Farmers' Clubs, and like associations can efficiently work with the Station for this purpose, by sending in duly authenticated samples early during each season of trade.

By recent Acts of Legislature it is made the business of this Station to examine commercial cattle feeds and articles used for human food or drink on sale in Connecticut, with reference to their adulterations.

Here it may be stated that, *until further notice,* the Station will examine only such samples of food and drink as are

collected by its agents or such as shall be taken under its advice, and by the methods it shall prescribe or approve.

All other work proper to the Experiment Station that can be used for the public benefit will be done without charge. Work for the private use of individuals is charged for at moderate rates. The Station undertakes no work the results of which are not at its disposal to use or publish, if deemed advisable for the public good.

Results of analysis or investigation that are of immediate general interest are published in Bulletins, copies of which are sent to each Post Office in the State, and to every citizen of the State who applies for them. The results of all the work of the Station are summed up in the Annual Reports made to the Governor.

It is the wish of the Board of Control to make the Station as widely useful as its resources will admit. Every Connecticut citizen who is concerned in agriculture, whether farmer, manufacturer, or dealer, has the right to apply to the Station for any assistance that comes within its province to render, and the Station will respond to all applications as far as lies in its power.

☞ Instructions and Forms for taking samples, and Terms for testing Fertilizers, Seeds, etc., for private parties sent on application.

☞ Parcels by Express, to receive attention, should be *prepaid*.

☞ Letters sent to individual officers are liable to remain unanswered in case the officer addressed is absent. All communications therefore should be directed simply to the

AGRICULTURAL EXPERIMENT STATION,
New Haven, Conn.

and all remittances should be made payable to the undersigned.

☞ Station Grounds, Laboratories, and Office are on Huntington Street, five minutes walk west from Whitney Avenue and 1⅝ miles north of City Hall.

☞ Huntington Street may be reached by Whitney Avenue Electric Cars, which leave the corner of Chapel and Church

Streets five times hourly, viz.: on the striking of the clock and at intervals of twelve minutes thereafter.

☞ The Station has telephone connection and may be spoken from the Central Telephone Office, 118 Court Street, or from Peck & Bishop's Office in Union R. R. Depot, New Haven.

☞ The Grass Garden, in charge of Mr. James B. Olcott, is near South Manchester, five minutes walk from the line of the Manchester Electric Cars, leaving City Hall Square, State Street, Hartford, every half hour. Conductors on this line can direct visitors to the Garden.

S. W. JOHNSON, *Director.*

Report of the Board of Control.

To His Excellency, George E. Lounsbury, Governor of Connecticut:

The Board of Control of the Connecticut Agricultural Experiment Station herewith submits its Report for the year ending October 31st, 1899:

The Fertilizer Control.

During the months of April, May and June, Mr. V. L. Churchill, the sampling agent of the Station, visited one hundred and nineteen towns and cities in Connecticut and drew from stock in the hands of dealers or purchasers, five hundred and ninety-six samples of commercial fertilizers. These samples represented all but six of the two hundred and ninety-two brands which were legally entered for sale in the State.

With these six exceptions, being brands which could not be found by our agent, one sample at least of every commercial fertilizer legally sold in the State has been analyzed during this year. A manuscript copy of the analysis has been sent to the manufacturer and to each dealer from whom a sample of the goods analyzed was taken, and the analyses are tabulated for publication in Part I of the Station Report.

Other examinations of commercial fertilizers and manurial waste products bring the total number of fertilizer analyses made within the year up to four hundred and sixty.

These analyses have been executed by Messrs. Winton, Ogden and Mitchell, with the assistance of Mr. Lange.

Examination of Food Products.

During the year ending July 31st, 1899, agents of the Station visited twenty-one towns and villages in this State, and bought in each one of them samples of food products for examination. Four hundred and sixteen samples have been subjected to chemical or microscopic examination, as appears

in Part II of the Report of the Station staff. The microscopic work was wholly done by Mr. Winton, the chemical work by Messrs. Winton, Ogden and Mitchell.

Examination of Commercial Cattle Feeds.

During the year ending November 1st, 1899, Messrs. Winton, Ogden and Mitchell have analyzed two hundred and forty-one samples of this class of feeds and the results will appear in Part II of the Report.

Work for the Dairy Commissioner.

All the chemical work required by the Dairy Commissioner has been done in the laboratory of this Station, involving three hundred and twenty-three analyses of butter and oleomargarine, molasses and syrup, vinegar, honey and coffee.

Other Chemical Work.

In connection with work on the availability of different kinds of fertilizer nitrogen, the chemists named have made partial analyses of twenty-eight samples of red-top grass, of one hundred and twenty samples of Hungarian grass, of four samples of carnations, and of eighteen of soil.

A large amount of work has also been done in studying analytical methods as well as qualitative methods for the detection of adulterants in food products.

Study of Proteids.

During the past year, Dr. Osborne, with the assistance of Mr. Campbell, has made a study of nucleic acid and the phosphorized proteids, nucleins, nucleoproteids and nucleo-albumins. The proteids of the egg-white and also of the egg-yolk have been investigated in detail, and a very thorough study has been made of the proteids of the embryo of the wheat-kernel.

Horticultural and Entomological Work.

The study of the relative availability of organic nitrogen in various forms has been continued by Messrs. Jenkins and

Britton, with the coöperation of the Station chemists. Sixty-two cultures of red-top grass, forty-eight of oats, ninety-five each of Hungarian grass and of rye, and forty-eight of privet have been made for this purpose, in galvanized iron pots charged with soil to which the several forms of nitrogen have been added.

During the winter, forty-eight comparative cultures of tomatoes, twelve of carnations and ten of lettuce were made on the benches of the forcing houses.

Mr. Britton has also given attention to the grafting of improved varieties of edible chestnuts to determine the proper season and the best method of setting chestnut cions in this State.

The entomological work of the Station has also been done by Mr. Britton. Besides correspondence and the determination of insect species sent to the Station to be identified, much attention has been given to a study of the San José scale; its present distribution in this State, its spread, and the means of abating and stopping its ravages by the use of insecticides.

In response to requests from nurserymen, Mr. Britton has made thirteen inspections of nurseries to determine whether or not dangerous insect or fungus pests were present and in nine cases has been able to give certificates that the nurseries were clear.

Seed Testing.

Two hundred and ninety-one samples of seeds, chiefly of vegetables and garden crops, have been tested as to their germinating power, in the interest of seed growers and purchasers.

Botanical Work.

Dr. Sturgis has made experiments on the effects of shading and applications of lime to prevent the trouble with tobacco known as "Calico," and on fractional fertilization of melons as a preventive of disease. He also contributes to the Report of the Station staff, papers on Further Notes on the Pole Burn of Tobacco, on the Prevention of Raspberry Anthracnose by Cultural Methods and Miscellaneous Notes on Fungous Diseases.

Field Experiments.

Under the supervision of Mr. Jenkins the three experiments on the fertilization of peach orchards, chiefly to study the effects of different amounts of potash salts and of the forms of nitrogen best adapted to the crop, which were begun in 1896, have been continued, and in one of the orchards the first crop of peaches was gathered this year.

Tobacco Experiments.

Under the direction of Mr. Jenkins, the curing of wrapper leaf tobacco by artificial heat used to supplement the natural conditions, and the fermentation of this tobacco in bulk instead of in cases, have been studied this year with very gratifying results.

Station Publications.

The twenty-second Report of this Station, for the year 1898, a volume of 341 pages, has been issued in an edition of 7,000 copies. These have been distributed, after satisfying our exchanges, among the farmers of this State in response to applications.

Of the third Annual Report on Food Products, 10,000 extra copies were printed at the expense of the Station, and distributed in our cities and villages to intelligent citizens who are, presumably, interested in pure food, but are not reached by the regular edition that is intended for the use of agriculturists.

Bulletin No. 128, issued in April last, twelve pages, was entitled, "Commercial Feeding Stuffs in the Connecticut Market."

Bulletin No. 129, issued in May last, ten pages, treated of the "Inspection and Care of Nursery Stock."

Five thousand copies of each of these bulletins were printed and distributed and the substance of their contents is reproduced in the Report of the Station Staff for 1899, with appropriate emendations.

Correspondence.

During the year ending October 31, 1899, more than twenty-eight hundred letters and manuscript reports of fertilizer and other analyses have been written on Station business.

Changes in the Station Staff.

Mr. Walter Mitchell, who has for four years served most efficiently as chemist on the Station staff, resigned in September, to accept a more satisfactory position in a large manufacturing establishment. A few weeks later Mr. Clifford Langley was appointed to fill the vacancy.

Meetings of the Board.

During the year ending October 31st, the Board of Control has held three meetings.

All of which is respectfully submitted.

Wm. H. Brewer, *Secretary.*

REPORT OF THE TREASURER.

Wm. H. Brewer, in account with the Connecticut Agricultural Experiment Station for the fiscal year ending September 30, 1899.

RECEIPTS.

Balance from 1898,	$281.38	
State Appropriation, Agriculture,	10,000.00	
State Appropriation, Foods,	2,500.00	
United States Appropriation,	7,500.00	
Analysis Fees,	5,677.00	
Miscellaneous,	438.00	
		$26,396.38

DISBURSEMENTS.

S. W. Johnson, Salary,	$1,250.00
E. H. Jenkins, "	2,500.00
W. H. Brewer, "	499.70
V. E. Cole, "	800.00
W. C. Sturgis, "	1,000.00
T. B. Osborne, "	1,775.00
A. L. Winton, "	1,775.00
A. W. Ogden, "	1,675.00
G. F. Campbell, "	1,000.00
W. L. Mitchell, "	900.03
W. W. Mursick, "	150.00
C. Langley, "	30.77
W. E. Britton, "	1,175.00
H. Lange, "	720.00
J. B. Olcott, "	800.00
C. J. Rice, "	600.00
V. L. Churchill, "	600.00
Labor,	1,080.45
Publications,	567.27
Postage,	125.46
Stationery,	174.75
Telephone and Telegraph,	146.13
Freight and Express,	95.83
Gas,	464.93
Coal,	842.40
Water,	147.00
Chem. Laboratory,	1,209.36

Agr. and Hort. Supplies,	$126.60	
Miscellaneous Supplies,	119 39	
Fertilizers,	118.28	
Feeding Stuffs,	106.83	
Library,	512.45	
Tools and Implements,	192.53	
Furniture and Fixtures,	39.90	
Scientific Apparatus.	280.05	
Traveling, by the Board,	18.20	
Traveling, by the Staff,	155.46	
Tobacco Investigation,	423.79	
Fertilizer Sampling,	267.46	
Food Sampling,	177.43	
Unclassified Sundries,	263.03	
Betterments,	789.43	
Repairs,	572.65	
Grounds and the Establishment,	128.82	
		$26,396.38

Memorandum.—The accounts of the Treasurer have been duly audited by the State Auditors of Public Accounts. The Report of the Treasurer for the fiscal year of the United States ending June 30th, 1899, was duly rendered to the Secretary of the Treasury of the United States, and in duplicate to the Secretary of Agriculture.

In the accounts as here presented, the disbursements for "Fertilizers" are exclusive of those used in the special Grass and Tobacco investigations, and those for "Traveling by the Staff" are exclusive of money spent in the sampling of Fertilizers and Foods.

The above classification of Expenditures is in accordance with the requirements of the State laws regarding expenditures of the State appropriations, of the requirements of the Secretary of the Treasury of the United States for the expenditure of the United States appropriation, and with the schedule prepared by the United States Secretary of Agriculture for use by all the Agricultural Experiment Stations of the country.

WM. H. BREWER,
Treasurer.

COMMERCIAL FERTILIZERS.

During 1898 fifty-four manufacturing firms have entered for sale in this State two hundred and ninety-two distinct brands of fertilizers, viz.:

Special manures for particular crops	109
Other nitrogenous superphosphates	109
Bone manures and "bone and potash"	37
Fish, tankage, castor pomace and chemicals	37
	292

The duties of this Station regarding fertilizers are prescribed by law as follows:

THE FERTILIZER LAW OF CONNECTICUT.

The General Assembly, in 1882, passed an act concerning Commercial Fertilizers, which, as amended in 1893, is now in force.

Attention is especially called to the following requirements of the law, the full text of which is printed on pages 3 and 4.

1. In case of *all* fertilizers or manures, except stable manure and the products of local manufacturers of less value than ten dollars a ton, the law holds the SELLER responsible for *affixing a correct label or statement* to every package or lot sold or offered, as well as for the *payment of an analysis fee* of ten dollars for each fertilizing ingredient which the fertilizer contains or is claimed to contain, *unless* the MANUFACTURER OR IMPORTER has provided labels or statements and has paid the fee. Sections 4005 and 4007.

The Station understands "the fertilizing ingredients" to be those whose determination in an analysis is necessary for a valuation, and which are generally Nitrogen, Phosphoric Acid, and Potash. The analysis fees in case of any fertilizer will, therefore, usually be ten, twenty, or thirty dollars, according as one, two or three of these ingredients are contained or claimed to exist in the fertilizer.

2. The law also requires, *in the case of every commercial fertilizer,* that a *sealed sample* shall be deposited with the Director

of the Station by the MANUFACTURER OR IMPORTER, and that a *certified statement* of composition, etc., shall be filed with him. Section 4006.

A statement of the percentage of Nitrogen, Phosphoric Acid (P_2O_5), and Potash (K_2O), and of their several states or forms, will suffice in most cases. Other ingredients may be named if desired.

In all cases the percentage of *nitrogen* must be stated. Ammonia may also be given when actually present in ammonia salts, and "ammonia equivalent to nitrogen" may likewise be stated.

The percentage of soluble and reverted phosphoric acid may be given separately or together, and the term "available" may be used in addition to, but not instead of, soluble and reverted.

The percentage of insoluble phosphoric acid may be stated or omitted.

In case of Bone, Fish, Tankage, Dried Meat, Dried Blood, etc., the chemical composition may take account of the two ingredients, Nitrogen and Phosphoric Acid.

For Potash Salts give always the percentage of Potash (potassium oxide): that of Sulphate of Potash or Muriate of Potash may also be stated.

The chemical composition of other fertilizers may be given as found in the Station Reports.

3. It is also provided that EVERY PERSON in the State, who sells *any commercial fertilizer of whatever kind or price,* shall annually report certain facts to the Director of the Experiment Station, and on demand of the latter shall deliver a sample for analysis. Section 4008.

4. All "CHEMICALS" that are applied to land, such as Muriate of Potash, Kainite, Sulphate of Potash and Magnesia, Sulphate of Ammonia, Nitrate of Potash, Nitrate of Soda, etc.—are considered to come under the law as "Commerical Fertilizers." Dealers in these chemicals must see that packages are suitably labeled. They must also report them to the Station, and see that the analysis fees are duly paid, in order that the Director may be able to discharge his duty as prescribed in Section 4013 of the Act.

It will be noticed that the State exacts no license tax either for making or dealing in fertilizers. For the safety of consumers and the benefit of honest manufacturers and dealers, the State requires that it be known what is offered for sale, and whether fertilizers are what they purport to be. With this object in view the law provides, in Section 4013, that all fertilizers be analyzed, and it requires the parties making or selling them to pay for these analyses in part; the State itself paying in part by maintaining the Experiment Station.

ACTS CONCERNING COMMERCIAL FERTILIZERS.

Chapter CCLIII of the General Statutes of Connecticut as amended by Chapter CLXXII of the Acts of the General Assembly, Session of 1893.

SECTION 4005. Every person or company who shall sell, offer, or expose for sale, in this State, any commercial fertilizer or manure except stable manure, and the products of local manufacturers of less value than ten dollars a ton, shall affix conspicuously to every package thereof a plainly printed statement clearly and truly certifying the number of net pounds of fertilizer in the package, the name, brand, or trademark under which the fertilizer is sold, the name and address of the manufacturer, the place of manufacture, and the chemical composition of the fertilizer, expressed in the terms and manner approved and usually employed by the Connecticut Agricultural Experiment Station.

If any such fertilizer be sold in bulk, such printed statement shall accompany every lot and parcel sold, offered, or exposed for sale.

SEC. 4006. Before any commercial fertilizer is sold, offered, or exposed for sale, the manufacturer, importer, or person who causes it to be sold, or offered for sale, within this State, shall file with the Director of the Connecticut Agricultural Experiment Station two certified copies of the statement prescribed in Section 4005, and shall deposit with said director a sealed glass jar or bottle containing not less than one pound of the fertilizer, accompanied by an affidavit that it is a fair average sample thereof.

SEC. 4007. The manufacturer, importer, agent, or seller of any commercial fertilizer shall pay on or before May 1, annually, to the Director of the Connecticut Agricultural Experiment Station, an analysis fee of ten dollars for each of the fertilizing ingredients contained or claimed to exist in said fertilizer: *provided,* that when the manufacturer or importer shall have paid the fee herein required for any person acting as agent or seller for such manufacturer or importer, such agent or seller shall not be required to pay the fee prescribed in this section.

SEC. 4008. Every person in this State who sells, or acts as local agent for the sale of any commercial fertilizer of whatever kind or price, shall annually, or at the time of becoming such seller or agent, report to the Director of the Connecticut Agricultural Experiment Station his name and brand of said fertilizer, with the name and address of the manufacturer, importer,

or party from whom such fertilizer was obtained, and shall, on demand of the Director of the Connecticut Agricultural Experiment Station, deliver to said director a sample suitable for analysis of any such fertilizer or manure then and there sold or offered for sale by said seller or agent.

SEC. 4009. No person or party shall sell, offer, or expose for sale, in this State, any pulverized leather, raw, steamed, roasted, or in any form, as a fertilizer or as an ingredient of any fertilizer or manure, without explicit printed certificate of the fact, such certificate to be conspicuously affixed to every package of such fertilizer or manure, and to accompany every parcel or lot of the same.

SEC. 4010. Every manufacturer of fish guano, or fertilizers of which the principal ingredient is fish or fish mass from which the oil has been extracted, shall, before manufacturing or heating the same, and within thirty-six hours from the time such fish or mass has been delivered to him, treat the same with sulphuric acid or other chemicals, approved by the director of said experiment station, in such quantity as to arrest decomposition: *provided, however,* that in lieu of such treatment such manufacturers may provide a means for consuming all smoke and vapors arising from such fertilizers during the process of manufacture.

SEC. 4011. Any person violating any provisions of the foregoing sections of this chapter shall be fined one hundred dollars for the first offense, and two hundred dollars for each subsequent violation.

SEC. 4012. This chapter shall not affect parties manufacturing, importing, or purchasing fertilizers for their own private use, and not to sell in this State.

SEC. 4013. The Director of the Connecticut Agricultural Experiment Station shall pay the analysis fees received by him into the treasury of the Station, and shall cause one or more analyses of each fertilizer to be made and published annually. Said director is hereby authorized, in person or by deputy, to take samples for analysis from any lot or package of manure or fertilizer which may be in the possession of any dealer.

SEC. 4014. The Director of the Connecticut Agricultural Experiment Station shall, from time to time, as bulletins of said Station may be issued, mail or cause to be mailed two copies, at least, of such bulletins to each post-office in the State.

OBSERVANCE OF THE FERTILIZER LAW.

Here follows an alphabetical list of the manufacturers who have paid analysis fees as required by the Fertilizer Law, and the names or brands of the fertilizers for which fees have been paid by them for the year ending May 1st, 1900.

Firm.	*Brand of Fertilizer.*
Armour Fertilizer Works, The, Chicago, Ills.	Ammoniated Bone with Potash, Grain Grower, All Soluble, Fruit and Root Crop Special.
Berkshire Mills Co., Bridgeport, Conn.	Berkshire Complete Fertilizer, " Potato Phosphate, " Ammoniated Bone Phosphate, " Ground Bone, " Columbian Phosphate.
Boardman, F. E., Little River, Conn.	Boardman's Complete Fertilizer for Potatoes and General Crops.
Bowker Fertilizer Co., 43 Chatham St., Boston, Mass.	Stockbridge Special Tobacco Manure, " " Corn Manure, " " Grass Top Dressing and Forage Crop Manure, " " Potato and Vegetable Manure, Bowker's Special Fertilizer, Potato and Vegetable, " Potato Phosphate, " Hill and Drill Phosphate, " Farm and Garden or Ammoniated Bone Fertilizer, " Fish and Potash, Square Brand, " Tobacco Starter, " Sure Crop Phosphate, " Market Garden Fertilizer, " Square Brand Bone and Potash, " Corn Phosphate, " Bone and Wood Ash Fertilizer, " Tobacco Ash Elements, " " " Fertilizer, " Middlesex Special, " Early Potato Manure, " Acid Phosphate, " Fisherman's Brand Fish and Potash, " Dry Ground Fish, Nitrate of Soda, Dissolved Bone-black,

Firm.	*Brand of Fertilizer.*
Bowker Fertilizer Co., 43 Chatham St., Boston, Mass.	Muriate of Potash, Fresh Ground Bone, Tankage, Canada Hardwood Ashes, Castor Pomace.
Bradley Fertilizer Co., 92 State St., Boston, Mass.	Bradley's Eclipse Phosphate, " Dry Fish Guano, High Grade Tobacco Manure, Farmers' New Method Fertilizer, B. D. Sea Fowl Guano, Triangle A Fish and Potash, Anchor Brand Fish and Potash, Circle Brand Ground Bone with Potash, Fine Ground Bone, Complete Manure for Corn and Grain, " " " Potatoes and Vegetables, Potato Manure, Superphosphate, Corn Phosphate, Potato Fertilizer, Tobacco Fertilizer, Niagara Phosphate.
Brightman, Wm. E., Gen'l Agent, Tiverton, R. I.	Brightman's Fish and Potash, " Tobacco Special and Market Garden Fertilizer, " Ammoniated Bone and Potash, " Dry Ground Fish.
Buckingham, C., Southport, Conn.	XX Formula.
Burwell, E. E., New Haven, Conn.	Double Sulphate of Potash, Muriate of Potash, Blood and Meat, Dissolved Bone Black, Nitrate of Soda.
Clark's Cove Fertilizer Co., The, Box 1779, N. Y. City.	Great Planet A., Bay State G. G., Sweepstakes Potato Manure, Potato Fertilizer, King Philip.
Cleveland Dryer Co., The, 92 State St., Boston Mass.	Superphosphate, High Grade Complete Manure, Potato Phosphate, Fertilizer.
Coe, E. Frank Co., 133-137 Front St., N. Y. City.	E. Frank Coe's High Grade Ammoniated Bone Superphosphate, " High Grade Potato Fertilizer, " Gold Brand Excelsior Guano, " Ground Bone and Potash, " Special Potato Fertilizer.

Firm.	*Brand of Fertilizer.*
Conn. Valley Orchard Co., Berlin, Conn.	C. V. O. Co.'s Fertilizer.
Cooper's Glue Factory, Peter, 17 Burling Slip, N. Y. City.	Bone Dust.
Crocker Fertilizer and Chemical Co., Buffalo, N. Y.	Crocker's Ammoniated Wheat and Corn Phosphate, " New England Tobacco and Potato Grower. " A. A. Complete Manure, " Special Potato Manure.
Cumberland Bone-Phosphate Co., State St. and Merchants Row, Boston, Mass.	Cumberland Superphosphate, " Concentrated Phosphate, " Potato Fertilizer, " Fertilizer, " Hawkeye Fertilizer, " Extra Fine Ground Bone.
Darling Fertilizer Co., L. B., Pawtucket, R. I.	Potato and Root Crop, Tobacco Grower, Blood, Bone and Potash, Dissolved Bone and Potash, Farm Favorite, Fine Bone.
Dennis, L. C., Stafford Springs, Conn.	Ground Bone.
Downs & Griffin, Derby, Conn.	Ground Bone.
East India Chemical Works, The, H. J. Baker & Bro., Prop's., 100 William St., N. Y. City.	Complete Tobacco Manure, "A A" Ammoniated Superphosphate, Complete Potato Manure, Harvest Home Fertilizer, Complete Corn Manure, Castor Pomace, Complete for General Use, Bone.
Ellsworth, F., Hartford, Conn.	Shoemaker's Swift Sure Bone Meal. " " " Superphosphate.
Frisbie, L. T. Co., The, Hartford, Conn.	Frisbie's Bone Meal, " Superphosphate.
Great Eastern Fertilizer Co., Rutland, Vt.	Garden Special, Vegetable, Vine and Tobacco, Northern Corn Special, General, Grass and Oats.
Hess, S. M. & Bro., Cor. 4th & Chestnut Sts., Philadelphia, Pa.	Potato and Truck Manure, Hess's Tobacco Manure, Keystone Bone Phosphate.
Kelsey, E. R., Branford, Conn.	Bone, Fish and Potash.
Lederer & Co., New Haven, Conn.	Pure Ground Bone.

Firm.	*Brand of Fertilizer.*
Lister's Agricultural Chemical Works, Newark, N. J.	Lister's Standard Pure Bone Superphosphate of Lime, " Animal Bone and Potash, " Success Fertilizer, " Potato Manure, " Special Potato Fertilizer.
Lowell Fertilizer Co., 44 No. Market St., Boston, Mass.	Swift's Lowell Bone Fertilizer, " " Animal Fertilizer, " " Potato Phosphate, " " Tobacco Manure, " " Ground Bone, " " Dissolved Bone and Potash, " " Market Garden, " " Fruit and Vine.
Ludlam, Frederick, 108 Water St., N. Y. City.	Cecrops Brand, Cereal Brand.
Manchester, E. & Sons, West Winsted, Conn.	Manchester's Formula.
Manock, Robert, Rockville, Conn.	Ground Bone.
Mapes, F. & P. G. Co., The, 143 Liberty St., N. Y. City.	Potato Manure, Economical Potato Manure. Complete Manure "A" Brand, Tobacco Starter Improved, Vegetable Manure or Complete Manure for Light Soils, Dissolved Bone, Tobacco Ash Constituents, " Manure, Wrapper Brand, Corn Manure, Cereal Brand, Fruit and Vine Manure. Grass and Grain Spring Top Dressing, Average Soil Complete Manure, Seeding Down Manure.
McCormack, W., Wolcott, Conn.	Ground Bone.
Miles, Geo. W., Agent, Milford, Conn.	I. X. L. Ammoniated Bone Superphosphate, Fish Guano.
Milsom Rendering & Fertilizer Co., 963 William St., East Buffalo, N. Y.	Buffalo Fertilizer, Corn Fertilizer, Potato, Hop and Tobacco Phosphate, Cyclone Pure Bone Meal, Vegetable Bone Fertilizer, Wheat, Oats and Barley Phosphate, Erie King, Buffalo Guano, Connecticut Wrapper, Potato Special, B. B. Guano, Dissolved Bone and Potash.

Firm.	*Brand of Fertilizer.*
National Fertilizer Co., Bridgeport, Conn.	Chittenden's Complete Fertilizers, " Ammoniated Bone, " Fish and Potash, " Market Garden, " Potato Phosphate, " Fine Ground Bone.
Niagara Fertilizer Works, The, Buffalo, N. Y.	Niagara Wheat and Corn Producer, " Potato, Tobacco and Hop Fertilizer.
Olds & Whipple, Hartford, Conn.	Bone Meal, O. and W. Special Phosphate, " Castor Pomace.
Pacific Guano Co., P. O. Box 1368, Boston, Mass.	Soluble Pacific Guano, Potato Special, High Grade General Fertilizer, Nobsque Guano, Grass and Grain Fertilizer, Fine Ground Bone.
Packer's Union Fertilizer Co., P. O. Box 1528, N. Y. City.	Animal Corn Fertilizer, Potato Manure, Universal Fertilizer, Wheat, Oats and Clover, Gardeners' Complete Manure.
Peck Bros., Northfield, Conn.	Pure Ground Bone.
Plumb & Winton Co., Bridgeport, Conn.	Ground Bone.
Preston Fertilizer Co., Greenpoint, L. I.	Potato Fertilizer, Ground Bone.
Quinnipiac Co., The, 92 State St., Boston, Mass.	Quinnipiac Phosphate, " Potato Manure, " " Phosphate, " Market Garden Manure, " Corn Manure, " Climax Phosphate, " Pure Bone Meal, " Fish and Potash, Pequot, " Uncas Bone Meal, " Special Potato, Muriate of Potash, Sulphate of Potash, Nitrate of Soda, Dry Ground Fish, Ammoniated Dissolved Bone, Fish and Potash, Crossed Fishes Brand.
Read Fertilizer Co., The, Box 3121, N. Y. City.	Read's Standard, Bone, Fish and Potash, Vegetable and Vine, High Grade Farmer's Friend, Leader Guano.

Firm.	*Brand of Fertilizer.*
Rogers & Hubbard Co., The, Middletown, Conn.	Hubbard's Pure Raw Knuckle Bone Flour, " Strictly Pure Fine Bone, " Fertilizer for Oats and Top Dressing, " Fertilizer for All Soils and All Crops, " Potato Phosphate, " Soluble Potato Manure, " Fairchild's Formula Corn and General Crops, " Soluble Tobacco Manure, " Grass and Grain Fertilizer.
Rogers Mfg. Co., The, Rockfall, Conn.	Pure Ground Bone, High Grade Soluble Potato, Complete Potato, " Corn, Oats and Top Dressing, High Grade Tobacco Manure, Grass and Grain Manure, Fish and Potash, All Round Fertilizer.
Russia Cement Co., Gloucester, Mass.	Essex Fish and Potash, " Complete Manure for Potatoes, Roots and Vegetables, " Complete Manure for Corn, Grain and Grass, " Corn Fertilizer, " Potato Fertilizer, " Tobacco Starter, " " Manure, " Dry Ground Fish.
Sanderson, L., New Haven, Conn.	Sanderson's Mixed Formula A, " Old Reliable Superphosphate, " Potato Manure, " Special with 10% Potash, " Nitrate of Soda, " Muriate of Potash, " Dissolved Bone Black, " Blood, Bone and Meat, " Fine Ground Bone, " Sulphate of Potash, " Pulverized Bone and Meat, " Fish, Luce Bros.' Bone, Fish and Potash.
Shay, C. M., Groton, Conn.	Groton Corn and Grain Manure, Mystic Gilt Edge Potato Manure, Ground Bone.
Standard Fertilizer Co., Farlow Building, State St., Boston, Mass.	Standard Fertilizer, " Special for Potatoes, " Guano, " Complete Manure.

Firm.	*Brand of Fertilizer.*
Tucker, Henry F. Co., Farlow Building, State St., Boston, Mass.	Tucker's Speci l Potato Fertilizer, " Original Bay State Bone Superphosphate, " Bay State Special Fertilizer, " Imperial Bone Superphosphate.
Wheeler, M. E. & Co., Rutland, Vt.	M. E. Wheeler's & Co.'s Superior Truck Fertilizer, " " " Havana Tobacco Grower, " " " High Grade Potato Manure, " " " High Grade Corn Fertilizer, " " " High Grade Fruit Fertilizer, " " " High Grade Grass and Oats, " " " High Grade Electrical Dissolved Bone, " " " High Grade Pure Ground Bone.
Wilcox Fertilizer Works, The, Mystic, Conn.	Potato, Onion and Tobacco Manure, Complete Bone Superphosphate, Potato Manure, High Grade Fish and Potash, Dry Ground Fish Guano.
Williams & Clark Fertilizer Co., 27 William St., N. Y. City.	Ammoniated Bone Superphosphate, Corn Phosphate, High Grade Special, Good Grower Potato Phosphate, Muriate of Potash, Dry Ground Fish, Potato Phosphate, " Manure, Royal Bone Phosphate, Pure Bone Meal, Nitrate of Soda, Kainit, Acid Phosphate, Tankage, Fish and Potash.

SAMPLING AND COLLECTION OF FERTILIZERS.

During April, May and June, Mr. V. L. Churchill, the sampling agent of this Station, visited one hundred and nineteen localities in Connecticut to draw samples of commercial fertilizers for analysis. These places were distributed as follows:

Litchfield County	11
Hartford County	29
Tolland County	11
Windham County	10
New London County	14
Middlesex County	13
New Haven County	17
Fairfield County	14
	119

In these places 596 samples were taken, representing all but six of the brands which have been entered for sale in this State.

These six brands, which the sampling agent was unable to find on sale and of which no samples were received from the manufacturers, are the following:

Armour & Co.'s Fruit and Root Crop, Special.
Bowker & Co.'s Stockbridge Tobacco Manure.
" " Dissolved Bone Black.
Clark's Cove Fertilizer Co.'s Sweepstakes Potato Manure.
Pacific Guano Co.'s High Grade General Fertilizer.
" " Ground Bone.

It has not been possible, therefore, for the Station to make analyses of these six fertilizers.

When several samples of a single brand are drawn in different parts of the State, the analysis is usually performed, not on any single sample, but on a mixture made of equal weights of all of the several samples. Thus, it is believed, the average composition of the goods is more fairly represented than by the analysis of single samples.

The Station agent is instructed in every case to open at least three packages of each brand for sampling, and, if the number of packages is very large, to take a portion from every tenth one, by means of a sampling tube which withdraws a section or core through the entire length of the bag or barrel.

As a rule, the Station will not analyze samples taken—

1. From dealer's stock of less than one ton.
2. From stock which has lain over from last season.
3. From stock which evidently is improperly stored, as in bags lying on wet ground or exposed to the weather, etc.

The Station desires the coöperation of farmers, farmers' clubs and granges in calling attention to new brands of fertilizers, and in securing samples of all goods offered for sale. *All samples must be drawn in strict accordance with Station's Instructions for Sampling, and must also be properly certified,* if the Station analysis is desired. A copy of these instructions and blank certificates will be sent on application.

ANALYSES OF FERTILIZERS.

During the year, four hundred and fifty-nine samples of commercial fertilizers and manurial waste-products have been analyzed. A classified list of them is given on page 21.

On a few of these samples, analyses were made for private parties and charged for accordingly. A few others were analyzed at the request of other experiment stations in order to compare and test analytical methods. Results of the examination of all the samples, with these exceptions, are given in detail in the following pages. When the contrary is not stated, the samples were drawn by an agent of the Station.

Samples are analyzed as promptly as possible in the order in which they are received. As soon as an analysis is completed a copy of it is sent to the party who furnished the sample, and also to the manufacturer, in order that there may be opportunity for correction or protest, before the results are published.

The following "Explanations" are intended to embody the principles and data upon which the valuation of fertilizers is based, a knowledge of which is essential to a correct understanding of the analyses that are given on subsequent pages.

EXPLANATIONS CONCERNING THE ANALYSIS OF FERTILIZERS AND THE VALUATION OF THEIR ACTIVE INGREDIENTS.*

The Elements of Fertilizers.

The three chemical elements whose compounds chiefly give value, both commercial and agricultural, to fertilizers, are Nitrogen, Phosphorus, and Potassium. The other elements found in fertilizers, viz.: Sodium, Calcium, Magnesium, Iron, Silicon, Sulphur, Chlorine, Carbon, Hydrogen, and Oxygen, which are necessary or advantageous to the growth of vegetation, are either so abundant in the soil or may be so cheaply supplied to crops, that they do not considerably affect either the value or cost of high-priced commercial fertilizers.

Nitrogen in fertilizers is, on the whole, the least abundant of their valuable elements, and is, therefore, their most costly ingredient.

Free Nitrogen is universally abundant, making up nearly four-fifths of the common air, and appears to be directly assimilable by various low vegetable organisms, and with aid of certain bacteria, by leguminous plants (the clovers, alfalfa, peas, beans, lentils, esparsette, lupins, vetches, lathyrus, peanut, yellow locust, honey locust, etc.), and by a few non-leguminous plants, carrying root nodules, viz.: the Oleasters (*Eleagnus*), the *Alders* (*Alnus*), and a single family of coniferous trees (*Podocarpus*), but not at all, according to present evidence, by the cereals or other field and garden crops.

Organic Nitrogen is the nitrogen of animal and vegetable matters which is chemically united to carbon, hydrogen, and oxygen. Some forms of organic nitrogen, as those of blood, flesh, and seeds, are highly active as fertilizers; others, as found in leather and peat, are comparatively slow in their effect on vegetation, unless these matters are chemically disintegrated. Since organic nitrogen may often readily take the form of ammonia, it has been termed *potential ammonia.*

Ammonia (NH_3) *and Nitric Acid* (N_2O_5) are results of the chemical change of *organic nitrogen* in the soil and manure heap, and contain nitrogen in its most active forms. They occur in commerce—the former in sulphate of ammonia, the latter in nitrate of soda: 17 parts of ammonia, or 66 parts of pure sulphate of ammonia, contain 14 parts of nitrogen: 85 parts of pure nitrate of soda also contain 14 parts of nitrogen.

Phosphorus is, next to nitrogen, the most costly ingredient of fertilizers, wherein it exists in the form of phosphates, usually those of calcium, iron, and aluminum, or in case of "superphosphates," to some extent in the form of free phosphoric acid.

Water-soluble Phosphoric Acid is phosphoric acid (or a phosphate) that freely dissolves in water. It is the characteristic ingredient of super-

* Prepared and revised by the Director.

phosphates, in which it is produced by acting on "insoluble" (or "citrate soluble") phosphates, with diluted sulphuric acid. Once well incorporated with the soil, it gradually "reverts" and becomes insoluble, or very slightly soluble, in water.

Citrate-soluble Phosphoric Acid signifies the phosphoric acid (of various phosphates) that is freely taken up by a hot strong solution of neutral ammonium citrate, which solution is, therefore, used in analysis to determine its quantity. The designation *citrate-soluble* is synonymous with the less explicit terms *reverted, reduced,* and *precipitated,* which all imply phosphoric acid that was once easily soluble in water, but from chemical change has become insoluble in that liquid.

Recent investigation tends to show that water-soluble and citrate-soluble phosphoric acid are on the whole about equally valuable as plant food, and of nearly equal commercial value. In some cases, indeed, the water-soluble gives better results on crops; in others, the "reverted" is superior. In most instances there is probably little to choose between them.

Insoluble Phosphoric Acid implies various phosphates insoluble both in water and in hot solution of neutral ammonium citrate. The phosphoric acid of Canadian "Apatite," of South Carolina and Florida "Rock Phosphate," and of similar dense mineral phosphates, as well as that of "bone ash" and "bone black," is mostly insoluble in this sense, and in the majority of cases gives no visible good results when these substances, in the usual ground state, are applied to crops. They contain, however, a small proportion of citrate-soluble phosphoric acid, and sometimes, when they are reduced to extremely fine dust (floats) or applied in large quantities, especially on "sour soils" or in conjunction with abundance of decaying vegetable matter (humus), they operate as efficient fertilizers.

Available Phosphoric Acid is an expression properly employed in general to signify phosphoric acid in any form, or phosphates of any kind that serve to nourish vegetation. In the soil, phosphoric acid and all phosphates, whatever their solubilities, as defined in the foregoing paragraphs, are more or less freely and extensively available to growing plants. Great abundance of "insoluble" phosphoric acid may serve crops equally well with great solubility of a small supply, especially when the soil and the crop carry with them conditions highly favorable to the assimilation of plant food.

In Commercial Fertilizers, "available phosphoric acid" is frequently understood to be the sum total of the "water-soluble" and the "citrate-soluble," with the exclusion of the "insoluble."

The "insoluble phosphoric acid" in a commercial fertilizer costing $20 to $50 per ton, has very little or no value to the purchaser, because the quantity of it which can commonly go upon an acre of land has no perceptible effect upon the crop, and because its presence in the fertilizer excludes an equal percentage of more needful and much more valuable ingredients.

In Raw Bone the phosphoric acid (calcium phosphate) is nearly

insoluble, because of the animal matter of the bones which envelopes it; but when the animal matter decays in the soil, or when it is disintegrated by boiling or steaming, the phosphate mostly remains in an available form. The phosphoric acid of "Basic-Slag" and of "Grand Cayman's Phosphate" is in some soils as freely taken up by crops as water-soluble phosphoric acid, but in other soils is much less available than the latter.

Phosphoric acid in all the Station analyses is reckoned as "anhydrous phosphoric acid," (P_2O_5), also termed among chemists phosphoric anhydride, phosphoric oxide, and phosphorus pentoxide.

Potassium is the constituent of fertilizers which ranks third in costliness. In plants, soils, and fertilizers, it exists in the form of various salts, such as chloride (muriate), sulphate, carbonate, nitrate, silicate, etc. Potassium itself is scarcely known except as a chemical curiosity.

Potash signifies the substance known in chemistry as potassium oxide (K_2O), which is reckoned as the valuable fertilizing ingredient of "potashes" and "potash salts." In these it should be freely soluble in water and is most costly in the form of sulphate, and cheapest in the form of muriate (potassium chloride). In unleached ashes of wood and of cotton-seed hulls it exists mainly as potassium carbonate.

Valuation of Fertilizers.

The valuation of a fertilizer, as practised at this Station, consists in calculating the *retail Trade-value* or *cash-cost* (in raw material of good quality) of an amount of nitrogen, phosphoric acid, and potash equal to that contained in one ton of the fertilizer.

Plaster, lime, stable manure, and nearly all of the less expensive fertilizers have variable prices, which bear no close relation to their chemical composition, but guanos, superphosphates, and similar articles, for which $20 to $50 per ton are paid, depend for their trade-value exclusively on the substances, *nitrogen, phosphoric acid, and potash,* which are comparatively costly and steady in price. The trade-value per pound of these ingredients is reckoned from the current market prices of the standard articles which furnish them to commerce.

The consumer, in estimating the reasonable price to pay for high-grade fertilizers, should add to the *Trade-value of the above-named ingredients* a suitable margin for the expenses of manufacture, etc., and for the convenience or other advantage incidental to their use.

Trade-Value of Fertilizer Elements for 1899.*

The average trade-values or retail costs in market, per pound, of the ordinarily occurring forms of nitrogen, phosphoric acid, and potash in raw materials and chemicals, as found in New England, New York and New Jersey markets during 1898 were as follows:

*Adopted at a conference of representatives of the Connecticut, Massachusetts, New Jersey, and Rhode Island Stations held in March, 1899.

	Cents per pound.
Nitrogen in ammonia salts	15
in nitrates	12½
Organic nitrogen, in dry and fine-ground fish, meat, and blood, and in mixed fertilizers	14
in fine* bone and tankage	14
in coarse* bone and tankage	10
Phosphoric acid, water-soluble	4½
citrate-soluble†	4
of fine* ground fish, bone, and tankage	4
of coarse* fish, bone, and tankage	2
of cotton-seed meal, castor pomace, and ashes	4
of mixed fertilizers, if insoluble in ammonium citrate†	2
Potash as high-grade sulphate and in forms free from muriate (or chlorides)	5
as muriate	4¼

The foregoing are, as nearly as can be estimated, the prices at which, during the six months preceding March last, the respective ingredients were retailed for cash, in our large markets, in those *raw materials* which are the regular source of supply. They also correspond to the average wholesale price for the six months ending March 1st, plus about 20 per cent. in case of goods for which we have wholesale quotations. The valuations obtained by use of the above figures will be found to correspond fairly with the *average retail prices at the large markets, of standard raw materials, such as the following:*

Sulphate of Ammonia,	Muriate of Potash,
Nitrate of Soda,	Sulphate of Potash,
Dried Blood,	Plain Superphosphates,
Azotin,	Dry Ground Fish,
Ammonite,	Bones and Tankage,

Ground South Carolina Rock.

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*In this report "fine," as applied to bone and tankage, signifies smaller than $^1/_{50}$ inch; and "coarse," larger than $^1/_{50}$ inch. From 1878 on for 10 years, we distinguished five grades of bone, as to fineness. In 1888, one, in 1897, two of the coarser grades were dropped from the list. The smaller grades remain unchanged in dimensions, but "coarse" was for the first 10 years larger than ⅛ inch, for the next 9 years included all larger than $^1/_{12}$ inch, for the next year all larger than $^1/_{25}$ inch, and in this year all larger than $^1/_{50}$ inch; the former "coarse-medium," "medium," and "fine-medium" having been successively merged in "coarse."

This simply means that the three coarser grades that made up a large share of ground bone twenty years ago have gradually ceased to come into the market, there being no demand for them.

†Dissolved from 2 grams of the fertilizer, previously extracted with pure water, by 100 cc. neutral solution of ammonium citrate, sp. gr. 1.09, in thirty minutes, at 65° C., with agitation once in five minutes. Commonly called "reverted" or "backgone" Phosphoric Acid.

Valuation of Superphosphates, Special Manures and Mixed Fertilizers of High Grade.

The Organic Nitrogen in these classes of goods is reckoned at the price of nitrogen in raw materials of the best quality,* 14 cents.

Insoluble Phosphoric Acid is reckoned at 2 cents per pound. Potash is rated at 4¼ cents, if sufficient chlorine is present in the fertilizer to combine with it to make muriate. If there is more Potash present than will combine with the chlorine, then this excess of Potash is reckoned at 5 cents per pound.

In most cases the valuation of the ingredients in superphosphates and specials falls below the retail price of these goods. The difference between the two figures represents the manufacturer's charges for converting raw materials into manufactured articles and selling them. The charges are for grinding and mixing, bagging or barreling, storage, and transportation, commission to agents and dealers, long credits, interest on investments, bad debts, and, finally, profits.

The majority of the manufacturers agree that the average cost of mixing, bagging, handling, and cartage ranges from $3 to $4.50 per ton.

In 1899 the average selling price of Ammoniated Superphosphates and Guanos was $29.54 per ton, the average valuation was $19.55, and the difference $9.99, an advance of 51.1 per cent. on the valuation and on the wholesale cost of the fertilizing elements in the raw materials.

In case of special manures the average cost was $32.64, the average valuation $21.76, and the difference $10.88 or 50.0 per cent. advance on the valuation.

To obtain the Valuation of a Fertilizer we multiply the pounds per ton of nitrogen, etc., by the trade-value per pound. We thus get the values per ton of the several ingredients, and adding them together we obtain the total valuation per ton.

In case of *Ground Bone and Tankage,* the sample is sifted into the two grades just specified (see footnote, page 17), and we separately

*This concession gives the dishonest manufacturer the opportunity to defraud the consumer very easily and very seriously, by "working off" inferior or almost worthless leather, bat guano, and similar materials which "analyze well," containing up to 8 or 9 per cent. of nitrogen, much or all of which may be quite inert. Since the Station has had no practicable means of determining with certainty the amount of worthless nitrogen or the quality of the nitrogen in a mixed fertilizer, and since honest and capable manufacturers generally claim to use only "materials of the best quality," it would be unjust to them to assume that these fertilizers contain anything inferior. Farmers should satisfy themselves that they are dealing only with honest and with intelligent manufacturers. This can be done at little cost by such co-operation as Farmers' Clubs and Granges may practice, sending a competent and trusty agent to visit factories frequently and unexpectedly and take samples of raw materials. Honorable manufacturers will be glad to show all their raw materials and processes to their customers, especially if such inspection is insisted on as a preliminary to business. Coöperation may thus insure satisfactory quality of goods, as well as reduced cost.

compute the nitrogen-value of each grade by multiplying the pounds of nitrogen per ton by the per cent. of each grade, multiplying one-tenth of that product by the trade-value per pound of nitrogen in that grade, and taking this final product as the result in cents. Summing up the separate values of each grade thus obtained, together with the values of each grade of phosphoric acid, similarly computed, the total is the Valuation of the sample of bone.

Uses and Limitations of Fertilizer Valuation.

The uses of the "Valuation" are two-fold:

1. To show whether a given lot or brand of fertilizer is worth, as a commodity of trade, what it costs. If the selling price is not higher than the valuation, the purchaser may be tolerably sure that the price is reasonable. If the selling price is twenty to twenty-five per cent. higher than the valuation, it may still be a fair price; but in proportion as the cost per ton exceeds the valuation there is reason to doubt the economy of its purchase.

2. Comparisons of the valuation and selling prices of a number of similar fertilizers will generally indicate fairly which is the best for the money.

But the valuation is not to be too literally construed, for in some cases analysis cannot discriminate positively between the active and the inert forms of nitrogen, while the mechanical condition of a fertilizer is an item whose influence cannot always be rightly expressed or appreciated.

For the above first-named purpose of valuation, the trade-values of the fertilizing elements which are employed in the computations should be as exact as possible, and should be frequently corrected to follow the changes of the market.

For the second-named use of valuation frequent changes of the trade-value are disadvantageous, because two fertilizers cannot be compared as to their relative money-worth when their valuations are deduced from different data.

Experience leads to the conclusion that the trade-values adopted at the beginning of the year should be adhered to as nearly as possible throughout the year, notice being taken of considerable changes in the market, in order that due allowance may be made therefor.

Percentage Difference Between Cost and Valuation.

Among the 109 brands of fertilizers classed in this Report as "Nitrogenous Superphosphates," whose analyses are tabulated on pages 48-61, Nos. 12454 and 12651 stand at the extremes of cost, the retail price of the former being $45, and that of the latter $16. The Station Valuation of the former is $33.19, which is the highest of all these brands and the Station Valuation of the latter is $10.35, which is the lowest with a single exception. It is easily reckoned that the cost of the first is less than three times that of the second and that the valuation of

the first is more than three times that of the second, but to make a close comparison of these with each other and with the 107 other brands requires a somewhat different calculation.

We obtain a just basis for comparing any number of fertilizers by taking the valuation in each one as 100 and reckoning by "rule of three" the proportionate cost. This calculation is illustrated as follows, with the two fertilizers above noted and three others whose analyses are given in the same table on pages 48-61:

Station No.	Cost.	Valuation.	Difference of Cost and Valuation.	
12380	($20)	$21.24 : 100 ::	1.24 :	5.8
12454	(45)	33.19 : 100 :	11.81 :	35.6
12651	(16)	10.35 : 100 ::	5.62 :	54.6
12374	(37)	24.01 : 100 ::	12.29 :	54.1
12577	(25)	10.19 : 100 ::	14.81 :	145.3

The last terms in the above statements are the *percentage differences between cost and valuation.*

The first fertilizer, No. 12380, differs from all the others in the Table of Analyses covering pages 48 to 61 inclusive, in the fact that the *Valuation is greater than the Cost.* Accordingly the percentage difference between cost and valuation is *subtracted* from 100 to give the cost (at average rates) of 100 cents worth, which is thus found to be 94 cents in round numbers.

In case of the other fertilizers, the cost is greater than the valuation. The cost of 100 cents worth is therefore found by *adding* the percentage difference to 100.

No. 12454 is the highest priced of all the 109 brands whose analyses are printed on pp. 48 to 61, and the percentage difference shows that one dollar's worth sold for $1.35.

The two fertilizers, Nos. 12651 and 12374, though so unlike in selling price and valuation, closely agree in one respect, viz., that of them both one dollar's worth sold for $1.54.

Finally, one dollar's worth of No. 12577 sold for $2.45.

Agricultural Value of Fertilizers.

The Agricultural Value of a fertilizer is measured by the benefits received from its use, and depends upon its fertilizing effect, or crop-producing power. As a broad, general rule, it is true that ground bone, superphosphates, fish scraps, dried blood, potash salts, etc., have a high agricultural value which is related to their trade-value, and to a degree determines the latter value. But the rule has many exceptions, and in particular instances the trade-value cannot always be expected to fix or even to indicate the agricultural value. Fertilizing effect depends largely upon soil, crop, and weather, and as these vary from place to place, and from year to year, it cannot be foretold or estimated except by the results of past experience, and then only in a general and probable manner.

CLASSIFICATION OF FERTILIZERS ANALYZED.

RAW MATERIALS.

	No. of Samples.
1. *Containing Nitrogen as the Chief Valuable Ingredient.*	
Nitrate of Soda	12
Dried Blood	1
Cotton Seed Meal	35
Castor Pomace	7
2. *Containing Phosphoric Acid as the Chief Valuable Ingredient.*	
Dissolved Bone Black	6
Dissolved Rock Phosphate	9
3. *Containing Potash as the Chief Valuable Ingredient.*	
High Grade Sulphate of Potash	3
Double Sulphate of Potash and Magnesia	3
Muriate of Potash	12
Kainit	1
4. *Containing Nitrogen and Phosphoric Acid.*	
Bone Manures	51
Tankage	13
Fish	12
MIXED FERTILIZERS.	
Bone and Potash	6
Nitrogenous Superphosphates	121
Special Manures	110
Home Mixtures	8
MISCELLANEOUS FERTILIZERS AND MANURES.	
Cotton Hull Ashes	37
Unleached Canada Ashes	12
Leached Ashes	1
Total	459

DESCRIPTION AND ANALYSES OF FERTILIZERS.*

The samples referred to in the following pages, unless the contrary is stated, were drawn by an agent of the Station.

I. RAW MATERIALS CHIEFLY VALUABLE FOR NITROGEN.

NITRATE OF SODA OR SODIUM NITRATE.

Nitrate Soda is mined in Chili and purified there before shipment. It contains about 16 per cent. of nitrogen, equiva-

*This chapter has been prepared for publication by Dr. Jenkins. The analyses of fertilizers have all been made by Messrs. Winton, Ogden, and Mitchell, chemists of the Station, with the assistance of Mr. Lange.

lent to 97 per cent. of pure sodium nitrate. The usual guarantee is "96 per cent." of sodium nitrate, equivalent to 15.8 per cent. of nitrogen.

In rare cases cargoes have been found to contain sodium perchlorate, which, even in small amount, is very injurious to vegetation.

Eight analyses of nitrate of soda are given in a following table. The percentage of nitrogen ranges from 15.52, equivalent to 94.2 per cent. of nitrate,—to 16.00. All the samples are therefore of fair to good quality.

The price ranged from $40 to $45 per ton.

The cost of nitrogen in nitrate of soda has ranged from 12.6 to 14.5 cents per pound, the average cost being 13.9 cents, a fraction of a cent higher than in the previous year.

ANALYSES OF NITRATE OF SODA.

Station No.	Sold by	Sampled from Stock of	Nitrogen.	Equivalent Nitrate.	Cost per ton.	Nitrogen costs cents per pound.
12283	E. E. Burwell, New Haven	E. E. Burwell, New Haven	15.84	96.2	$40.00	12.6
12305	Bowker Fertilizer Co., Boston, Mass.	F. B. Northam, East Hampton	15.52	94.2	42.00	13.5
12366	Read Fertilizer Co., New York City	Adams & Canfield, Winnipauk	16 00	97.1	45.00	14.1
12284	L. Sanderson, New Haven	L. Sanderson, New Haven	15.94	96.8	45.00	14.1
12304	Rogers & Hubbard Co., Middletown	A. E. Kilbourne, East Hartford	15.60	94.7	45.00	14.4
12626	Williams & Clark Fertilizer Co., New York City	J. G. Schwink, Meriden	15.53	94.3	45.00	14.5
12303	Quinnipiac Co., Boston, Mass.	Olds & Whipple, Hartford	15.52	94.2	45.00	14.5
12174	----	S. D. Woodruff & Sons, Orange	15.52	94.2	----	----

DRIED BLOOD.

This consists of slaughter-house blood which has been dried by superheated steam or hot air. It is a finely pulverized, nearly odorless substance, red or nearly black in color, and rich in nitrogen that is quickly available to vegetation.

12294. Dried Blood, sampled by Station agent from stock of E. E. Burwell, New Haven.

This sample contained 13.68 per cent. of nitrogen (equivalent to 16.6 per cent. of "ammonia"), and 0.32 per cent. of phosphoric acid. It cost $37.00 per ton. The nitrogen cost 13.1 cents per pound.

COTTON SEED MEAL.

This material is of two kinds, which are known in trade respectively as undecorticated and decorticated. In their manufacture cotton seed is first ginned to remove most of the fiber, then passed through a "linter" to take off the short fiber or lint remaining, then through machines which break and separate the hulls. The hulled seed is ground and the oil expressed. The ground cake from the presses is used as a cattle food and fertilizer. The hulls are burned for fuel in the oil factory, and the ashes, which contain from 20 to 30 per cent. of potash, are also used as a fertilizer. In case of undecorticated meal, the hulls and the ground press-cake are mixed together.

The only samples received for analysis this year have represented clear, decorticated meal.

In the table, page 24, are given the percentages of nitrogen in thirty-two samples. The percentage of phosphoric acid in cotton seed meal ranges from 2.69 to 3.44, and that of potash from 1.64 to 2.00, the average being 3.15 and 1.90, respectively. The cost per pound of nitrogen is determined in each case by deducting from the ton price $4.42—the valuation of the phosphoric acid and potash,—and dividing the remainder by the number of pounds of nitrogen in the ton of meal.

The average cost of cotton seed meal has been about $22.80 per ton. The percentage of nitrogen has ranged from 6.72 to 7.63 and has averaged 7.14. The cost of nitrogen per pound has ranged from 11.9 to 14.6 cents, averaging 12.9 cents per pound, nearly a cent and a half per pound more than last year, but still the cheapest form of quickly available organic nitrogen in our market.

CASTOR POMACE.

This is the ground residue of castor beans from which castor oil has been extracted. The nitrogen which it contains is quickly available to plants, but the pomace is extremely poisonous to animals, which often eat it greedily when the opportunity offers.

Analyses of Cotton Seed Meal.

Station No.	Dealer.	Sampled by	Per Cent. of Nitrogen.	Cost per ton.	Nitrogen costs cents per pound.
12460	W. S. Pinney, Suffield	W. H. Prout, Suffield	7.17	$21.25	11.7
12183	W. W. Cooper, Suffield	Horatio J. Lathrop, Suffield	6.92	21.00	12.0
12279	Olds & Whipple, Hartford	Clark Brothers, Poquonock	7.27	22.00	12.1
12324	W. F. Fletcher, Southwick, Mass.	John B. Cannon, West Suffield	7.18	22.00	12.2
12357	Arthur Sikes, Suffield	Ernest N. Austin, Suffield	7.50	22.75	12.2
12384	Arthur Sikes, Suffield	G. A. Douglass, Thompsonville	7.45	22.75	12.3
12523	Olds & Whipple, Hartford	F. W. Lester, Windsor Locks	7.10	22.00	12.3
12321	Ira B. Barnard, Tariffville	W. R. Holcomb, Tariffville	7.12	22.00	12.4
12322	Daniels Mills Co., Hartford	W. R. Holcomb, Tariffville	7.49	23.00	12.4
12356	Ernest N. Austin, Suffield	Ernest N. Austin, Suffield	7.36	22.75	12.5
12278	Olds & Whipple, Hartford	A. E. Holcomb, Poquonock	7 45	23 00	12.5
12504	J. E Perkins, Suffield	F. B. Hatheway, Windsor Locks	6.83	21 50	12.5
12361	W. W. Cooper, Suffield	E. S. Seymour, Windsor Locks	7.32	23.00	12.7
12547	C. H. Dexter & Sons, Windsor Locks	F. A. Hamilton, Warehouse Point	6.79	21.75	12.7
12399		A. E. Miskill, Broad Brook	7.30	23 00	12.7
12062	R. S. Cruttenden, Rockville	Andrew Kingsbury, Coventry	7.14	22.50	12.7
12029		F. B. Drew, Shelton	7.63	24.00	12.8
12063	R. S. Cruttenden, Rockville	Andrew Kingsbury, Coventry	6.99	22 50	12.9
12325		J. B. Parker, Poquonock	7.20	23 00	12.9
12397	Loomis Brothers, Granby	D. A. Merriam, Granby	6.90	22.25	12.9
12355	Bowker Fertilizer Co, Boston, Mass.	L. H. Brewer, Hockanum	7 17	23.00	13.0
12614	Bowker Fertilizer Co., Boston, Mass.	C. J. Dewey, Buckland	7.02	23.00	13.2
12461	August Pouleur, Windsor	T. W. Lester, Hayden Station	7.16	23 50	13.3
12438	August Pouleur, Windsor	August Pouleur, Windsor	7.04	23 60	13.6
12441	" " "	" " "	7.07	23.60	13.6
12437	" " "	" " "	7.04	23.60	13.6
12440	" " "	" " "	6.97	23.60	13.8
12439	" " "	" " "	6.98	23.60	13.8
12297	Daniels Mills Co., Hartford	Station Agent	6.72	24.00	14.5
12489	Olds & Whipple, Hartford	John Leonard, Burnside	7.04	25.00	14.6
12120	Chapin & Co., Boston, Mass.	H. K. Brainard, Thompsonville	7.16*	----	----
12119	" " " "	" " "	7.14*	----	----

* Damaged meal, "Off color."

12611. Stock of Olds & Whipple, Hartford. Sampled by W. E. Treat, Silver Lane.

12299. Stock of Olds & Whipple, Hartford. Sampled by E. P. Brewer, Silver Lane.

12354. Stock of Bowker Fertilizer Co., Boston. Sampled by L. H. Brewer, Hockanum.

12036. Oil Seeds Pressing Co., New York City. Sampled by C. H. Eno, Simsbury.

12302. Stock of Bowker's Branch, Hartford. Sampled by Station agent.

12301. Made by H. J. Baker & Bro., N. Y. City. Stock of Olds & Whipple, Hartford. Sampled by Station agent.

12488. Stock of Hartz Bros. Sampled by John Leonard, Burnside.

ANALYSES.

	12611	12299	12354.	12036	12302	12301	12488
Nitrogen	6.05	6.19	5.43	5.44	5.00	5.47	5.03
Phosphoric Acid ..	....	1.85	2.15	1.79	2.53	1.79	....
Potash	....	1.02	1.10	1.06	1.18	0.86	....
Cost per ton	$19.00	$20.00	$19.00	$19.00	$19.00	$20.00	$19.00
Nitrogen costs cents per pound*..	**13.5**	**14.1**	**14.9**	**15.1**	**15.8**	**16.2**	**16.3**

The percentage of nitrogen in these samples has ranged from five to over six and nitrogen has cost from 13.5 to 16.3 cents per pound. It is the most expensive form of organic nitrogen in the market and is used only by certain tobacco growers who have the impression that its effect on the quality of wrapper leaf is superior to that of cotton seed. Five years careful tests and observation at the experiment field at Poquonock failed to show any such superiority.

*Allowing four cents per pound for phosphoric acid and five cents for potash.

II. RAW MATERIALS OF HIGH GRADE CONTAINING PHOSPHORIC ACID AS THE CHIEF VALUABLE INGREDIENT.

DISSOLVED BONE BLACK.

Bone black, made by subjecting bone to a red heat without access of air, is used in sugar refineries to decolorize sugar solutions. The waste bone black, dried and treated with oil of vitriol, makes a "superphosphate" of high grade which does not cake together on standing, but remains as a fine powder suitable for application to the land.

In the following table are given analyses of three samples of this material.

The cost of available phosphoric acid in dissolved bone black has ranged from 5.9 to 7.0 cents per pound.

This material is becoming very scarce in market, because much less bone black is used in sugar refineries, and at present prices dissolved bone black is not an economical fertilizer.

ANALYSES OF DISSOLVED BONE BLACK AND (☞)

Station No.	Sold by	Sampled from Stock of
	Dissolved Bone Black.	
12289	E. E. Burwell, New Haven	E. E. Burwell, New Haven
12519	L. Sanderson, New Haven†	
12288	L. Sanderson, New Haven	L. Sanderson, New Haven
12313	Quinnipiac Co., Boston	Olds & Whipple, Hartford
12521	Quinnipiac Co., Boston†	Olds & Whipple, Hartford
	Dissolved Rock Phosphate.	
12171	Berkshire Mills Co., Bridgeport	Berkshire Mills Co., Bridgeport, by S. E. Curtis, Stratford
12267	Bowker Fertilizer Co., Boston, Mass.	F. T. Bradley, Saybrook
12624	M. E. Wheeler, Rutland, Vt.*	W. H. Baldwin, Cheshire
12312	Williams & Clark Fertilizer Co., N. Y. City	J. G. Schwink, Meriden
12412	L. Sanderson, New Haven	Theodore Fowler, North Guilford
12367	Read Fertilizer Co., New York City	Adams & Canfield, Winnipauk
12311	Bowker Fertilizer Co., Boston, Mass.	F. B. Northam, East Hampton
12176		S. D. Woodruff & Sons, Orange

* "Electrical Dissolved Bone." † Sampled by W. H. Brewer, Silver Lane.

DISSOLVED ROCK PHOSPHATE OR ACID ROCK.

This material, made by treating various mineral phosphates with oil of vitriol, is the most common source of the phosphoric acid of factory-mixed fertilizers.

In the following table are given eight analyses of dissolved rock phosphate. The composition of the samples is by no means uniform.

The cost of available phosphoric acid ranges from 3.7 to 6.1 cents per pound, the average of seven samples being 4.6 cents.

12624. "Electrical Dissolved Bone," sold by M. E. Wheeler & Co., is simply dissolved mineral phosphate.

OF DISSOLVED ROCK PHOSPHATE.

Phosphoric Acid.				Cost per ton.	"Available" Phosphoric Acid costs cents per pound.
Soluble.	Reverted.	Insoluble.	Total.		
11.84	4.74	0.83	17.41	$20.00	5.9
15.20	3.05	0 24	18.49	23.00	6.3
16.21	0.22	0.08	16.61	22.00	6.7
16.78	0.26	0.12	17.16	24.00	7.0
17.02	0.08	0.09	17.19	24.00	7.0
12.58	2.77	0.50	15.85	11.50	3.7
9.76	3.70	1.38	14.84	12.00	3.9
5.00	10.52	1.04	16.56	15.00	4.7
9.65	5.28	1.18	16.11	13.00	4.2
6.74	8.59	2.00	17.33	15.00	4.6
4.80	8.09	2.77	15.66	15.00	5.4
9.12	3 51	1.22	13.85	16.00	6.1
12.42	2.80	0.50	15.72	----	---

III. RAW MATERIALS OF HIGH GRADE CONTAINING POTASH.

HIGH GRADE SULPHATE OF POTASH.

This chemical should contain over 90 per cent. of pure potassium sulphate (sulphate of potash) or about fifty per cent. of potassium oxide, the same quantity as is supplied by muriate, and should be nearly free from chlorine.

A single sample sent by a manufacturer was found to contain 8.67 per cent. of chlorine, which explained the considerable percentages of chlorine found in a tobacco fertilizer of which this potash salt was one of the ingredients.

Another firm made up a small lot of fertilizer which was brought into the State and guaranteed free from chlorine. Analysis, however, showed the presence of a considerable amount.

The manufacturer states that a lot of fifty tons of potash salts, bought for high grade sulphate and billed as such, contained over forty per cent. of chlorine.

In the table, on pages 30 and 31 are given two analyses of high grade sulphate, both of fair quality.

DOUBLE SULPHATE OF POTASH AND MAGNESIA.

This material is usually sold as "sulphate of potash" or "manure salt," on a guarantee of "48–50 per cent. sulphate," which is equivalent to 25.9–27.0 per cent. of potassium oxide. Besides some 46-50 per cent. of potassium sulphate, it contains over 30 per cent. of magnesium sulphate, chlorine equivalent to 3 per cent. of common salt, a little sodium and calcium sulphates, with varying quantities of moisture.

The three analyses given in the table on pages 30 and 31 show the usual percentage of potash, and from 1.88 to 2.45 per cent. of chlorine.

MURIATE OF POTASH.

Commercial muriate of potash contains about 80 per cent. of muriate of potash (potassium chloride), 15 per cent. or more of common salt (sodium chloride), and 4 per cent. or more of water.

It is generally retailed on a guarantee of 80 per cent. muriate, which is equivalent to 50.5 per cent. of potassium oxide.

The percentages of potash in the eight samples whose analyses appear in the tables, pages 30 and 31, range from 52.80 to 45.56, and average 50.83 per cent.

12615 was sent for analysis by C. J. Dewey, who stated that it was sold as muriate of potash and drawn with special care from stock of the Bowker Branch, Hartford. It contained 23.28 per cent. of potash, and as it contained much magnesia and sulphuric acid is evidently not muriate but probably double sulphate of potash and magnesia of poor quality. The price quoted was $40 per ton.

KAINIT.

Kainit is less uniform in composition than the other potash salts. It contains from 11 to 15 per cent. of potash, more than that quantity of soda, and rather less magnesia. These "bases" are combined with chlorine and sulphuric acid. Unless "calcined" it contains more water than occurs in sulphate or in muriate of potash. It is usually sold on a guarantee of 12 to 15 per cent. of potash, or 23 to 25 per cent. "sulphate of potash." It is not properly called, or claimed to be, a sulphate of potash, since it contains more than enough chlorine to combine with all the potash present, and there are sound reasons for believing that its potash exists chiefly as muriate and to a much less extent as sulphate. Its action and effects are unquestionably those of a muriate rather than of a sulphate.

A single analysis of kainit appears in the table, pages 30 and 31.

In 1899, the cost of potash in the samples of high grade sulphate of potash analyzed at this Station was about 5 cents per pound.

The cost of potash in the "low grade" or double sulphate of potash and magnesia ranged from 5.2 to 5.9 cents per pound, slightly higher than in the high grade sulphate.

In seven samples of muriate of potash, the cost per pound of potash ranged from 3.8 to 4.9 cents per pound, and averaged 4.2 cents, this being the cheapest source of water-soluble potash in the market.

The cost of potash in the sample of kainit was 5.1 cents per pound.

Analyses of (☞)

Station No.	Sold by	Sampled from Stock of
	High Grade Sulphate of Potash.	
12359	H. J. Baker & Bro., New York City	Ernest N. Austin, Suffield
12310	Bowker Fertilizer Co., Boston, Mass.	F. B. Northam, East Hampton
	Double Sulphate of Potash and Magnesia.	
12287	E. E. Burwell, New Haven	E. E. Burwell, New Haven
12620	L. Sanderson, New Haven	L. Sanderson, New Haven
12309	Quinnipiac Co., by Olds & Whipple, Hartford	Olds & Whipple, Hartford
	Muriate of Potash.	
12172	Berkshire Mills Co., Bridgeport	Berkshire Mills Co., by S. E. Curtis, Stratford
12306	Williams & Clark Fertilizer Co. N. Y. City	J. G. Schwink, Meriden
12286	L. Sanderson, New Haven	L. Sanderson, New Haven
12285	E. E. Burwell, New Haven	E. E. Burwell, New Haven
12308	Bowker Fertilizer Co., Boston, Mass.	F. B. Northam, East Hampton
12307	Quinnipiac Co., by Olds & Whipple, Hartford	Olds & Whipple, Hartford
12365	Read Fertilizer Co., New York City	Adams & Canfield, Winnipauk
12175		S. D. Woodruff & Sons, Orange
	Kainit.	
12553	Williams & Clark Fertilizer Co. New York City	J. G. Schwink, Meriden

Potash Salts.

Chlorine.	Per cent. of Potash.	Equivalent Sulphate of Potash.	Equivalent Muriate of Potash.	Cost per ton.	Potash costs cents per pound.
trace	49.30	91.2	----	$48.00	4.9
1.66	50.00	92.5	----	51.00	5.1
1.88	27.09	50.1	----	28.00	5.2
2.30	27.06	50.0	----	28.00	5.2
2.45	27.13	50.2	----	32.00	5.9
Not determin'd	52.26	----	82.8	40.00	3.8
"	51.59	----	81.7	40.00	3.9
"	52.80	----	83.6	42.50	4.0
"	49.29	----	78.1	41.00	4.2
"	51.79	----	82.0	44.00	4.2
"	51.73	----	81.9	45.00	4.3
"	45.56	----	72.2	45.00	4.9
"	51.65	----	81.8	----	---
"	12.78	----	20.3	13.00	5.1

IV. RAW MATERIALS CONTAINING NITROGEN AND PHOSPHORIC ACID.

BONE MANURES.

The terms "Bone Dust," "Ground Bone," "Bone Meal," and "Bone" applied to fertilizers, sometimes signify material made from dry, clean, and pure bones; in other cases these terms refer to the result of crushing fresh or moist bones which have been thrown out either raw or after cooking, with more or less meat, tendon, and grease, and—if taken from garbage or ash heaps—with ashes or soil adhering; again they denote mixtures of bone, blood, meat, and other slaughter-house refuse which have been cooked in steam tanks to recover grease, and are then dried and sometimes sold as "tankage"; or finally, they apply to bone from which a large share of the nitrogenous substance has been extracted in the glue manufacture. When they are in the same state of mechanical subdivision the nitrogen of all these varieties of bone probably has about the same fertilizing value.

The method adopted for the valuation of bone manures, which takes account of their mechanical condition as well as chemical composition, is explained on page 18.

1. *Bone Manures Sampled by Station Agents.*

In the table, pages 34 and 35, are given thirty-one analyses of samples of this class.

The price printed in full-face type in the column showing cost per ton is the one used in calculating the percentage difference between cost and valuation.

The average cost of these bone manures is $29.84 per ton; the average valuation $22.36; showing that the Station valuation has been lower than is justified by the average selling price of ground raw bone in Connecticut. It must however be remembered that boiled and steamed bone, quite finely ground, are put on our Connecticut market by large manufacturing establishments at prices much lower than can be quoted by our small local manufacturers for ground raw bone.

Analyses requiring special mention.

The analysis of Hubbard's Strictly Pure Fine Bone, **12414,** page 35, was unsatisfactory to the manufacturers in that the percentage of phosphoric acid found, 20.74, was stated by them to be lower than had ever before been found during the last twenty years.

Further samples were accordingly drawn and analyzed with the results given in analysis **12810,** page 35, which shows 22.23 per cent. of phosphoric acid.

The analysis of Bone made by the Rogers Manufacturing Co., **12418,** page 35, was made on a sample of a small lot of two tons and is stated by the manufacturers to unfairly represent the general quality of the regular brands made by them.

Bone Manures. Sampled by (☞)

Station No.	Name or Brand.	Manufacturer.
12619	Pure Bone Meal	L. T. Frisbee Co., Hartford
12893	Raw Bone Flour	Rogers Mfg. Co., Rockfall
12618	Ground Bone	Berkshire Mills, Bridgeport
12559	Pure Flour Bone	C. M. Shay, Groton
12561	Ground Bone	M. E. Wheeler, Rutland, Vt.
12556	Ground Bone	Lowell Fertilizer Co., Lowell, Mass.
12290	Ground Bone	L. Sanderson, New Haven
12371	Bone Fertilizer	Plumb & Winton, Bridgeport
12563	Fine Ground Bone	L. B. Darling, Pawtucket, R. I.
12415	Ground Bone	Downs & Griffin, Derby
12421	Bone Meal	M. L. Shoemaker & Co., Phila.
12810	Hubbard's Strictly Pure Fine Bone*	Rogers & Hubbard Co., Middletown
12416	Hubbard's Raw Knuckle Bone Flour	Rogers & Hubbard Co., Middletown
12418	Bone*	Rogers Mfg. Co., Rockfall
12417	Bone Meal	Quinnipiac Co., Boston, Mass.
12558	Uncas Bone Meal	Quinnipiac Co., Boston, Mass.
12557	Pure Fine Ground Steamed Bone Meal	
12315	Ground Bone	Bowker Fertilizer Co., Boston
12564	Extra Fine Ground Bone	Cumberland Bone Phosphate Co., Boston, Mass.
12422	Bone Dust	P. Cooper's Glue Factory, N. Y. C.
12423	Cyclone Bone Meal	Milsom Rend. & Fert. Co., East Buffalo, N. Y.
12369	Ground Bone	National Fertilizer Co., Bridgeport
12554	Ground Bone	East India Chem. Works, N. Y. C.
12370	Fine Ground Bone	Bradley Fertilizer Co., Boston
12414	Hubbard's Strictly Pure Fine Bone*	Rogers & Hubbard Co., Middletown
12617	Ground Bone	Robert Manock, Rockville
12424	Pure Ground Bone	Peck Brothers, Northfield
12419	Pure Ground Bone	Rogers Mfg. Co., Rockfall
12562	Pure Bone Meal	Williams & Clark Fert. Co., N.Y.C.
12368	Pure Ground Bone	Lederer & Co., New Haven
12555	Pure Ground Bone	E. C. Dennis, Stafford Springs

* See page 33.

Station Agent. Analyses.

Dealer.	Dealers' cash price per ton.	Valuation per ton.	Percentage difference between cost and valuation.	Chemical Analysis.		Mechanical Analysis.	
				Nitrogen.	Phosphoric Acid.	Finer than 1-50 inch.	Coarser than 1-50 inch.
City Coal&Wood Co., N. Brit'n	$26.00	$25.50	1.9	3.50	23.43	75	25
Manufacturer	32.00	28.97	10.5	3.82	26.04	81	19
Manufacturer	28.00	24.81	12.9	3.10	25.37	67	33
Z. J. Hinman, Collinsville	30.00	----	----	----	----	--	-
Manufacturer	30.00	26.31	14.0	2.30	29.82	71	29
E. F. Strong, Colchester	27.00	23.30	15.9	2.68	26.23	59	41
T. S. Bidwell, Canton Center	29.00	24.53	18.2	2.17	28.29	68	32
H. A. Bugbee, Willimantic	30.00	----	----	----	----	--	--
D. Beaslee, Ellington	30.00	----	----	----	----	--	--
	29.00	----	----	----	----	--	--
Manufacturer	28.00	23.35	19.9	3.35	25.10	52	48
Manufacturer	28.00	22.97	21.9	3.95	23.10	47	53
J. N. Ray, Greenwich	28.80	----	----	----	----	--	--
W. W. Cooper, Suffield	30.00	24.49	22.5	2.78	25.36	71	29
F. S. Bidwell, Windsor Locks	28.00	----	----	----	----	--	--
J. B. Parker, Jr., Poquonock	26.00	----	----	----	----	--	--
Manufacturer	30.00	23.61	27.1	2.28	27.66	62	38
Gault Bros., Westport	36.00	27.85	29.3	5.51	23.92	52	48
Strong & Tanner, E. Winsted	31.00	---	----	----	----	--	--
W. O. Goodsell, Bristol	30.00	23.13	29.7	4.08	22.23	50	50
W. C. Bulkley, Forestville	32.00	25.97	30.9	3.76	25.39	63	37
H. W. Andrews, Wallingford	33.00	----	----	----	----	--	--
	34.00	----	----	----	----	--	--
D. W. Spencer, Centerbrook	32.00	24.45	30.9	1.92	25.93	86	14
C. Buckingham, Southport	28.00	21.13	32.5	2.89	22.16	58	42
G. W. Williams Co., New London	32.00	----	----	----	----	--	--
C. Buckingham, Southport	25.00	18.73	33.5	2.42	19.73	61	39
Olds & Whipple, Hartford	30.00	21.65	38.6	1.14	29.81	58	42
F. B. Northam,† E. Hampton	26.00	18.61	39.7	2.54	23.33	37	63
Kahn Brothers, Yantic	27.00	19.19	40.7	2.68	19.77	59	41
Apothecaries' Hall Co., Waterbury	30.00	21.01	42.8	1.35	31.92	40	60
Charles H. Davis, Guilford	30.00	21.00	42.9	2.79	22.00	60	40
Manufacturer	------	22.35	43.1	3.63	22.93	49	51
Gault Brothers, Westport	32.00	----	----	----	----	--	--
Saxton & Strong, Bristol	35.00	23.91	46.4	3.79	23.44	56	44
C. O. Jelliff & Co., Southport	30.00	20.44	46.8	2.94	21.22	56	44
Kinsella & Smallhorn, New Canaan	32.00	----	----	----	----	--	--
H. W. Andrews, Wallingford	29.00	20.40	47.0	4.14	20.74	33	67
	30.00	----	----	----	----	--	--
Manufacturer	25.00	16.99	47.1	3.95	18.97	14	86
W. H. Scott & Co., Pequabuck	28.00	18.46	51.7	4.18	21.66	12	88
P. J. Bolan, Waterbury	28.00	----	----	----	----	--	--
Cadwell & Jones, Hartford	32.00	21.03	52.2	3.14	23.90	43	57
T. B. Atwater, Plantsville	32.00	20.81	53.8	2.86	21.77	58	42
F. S. Platt, New Haven	35.00	20.93	67.3	2.65	24.29	50	50
E. A. Buck, Willimantic	30.00	17.45	71.9	4.17	20.47	8	92

† Purchaser, not a dealer.

BONE MANURES. SAMPLED BY (☞)

Station No.	Name or Brand.	Manufacturer.
	Sampled by Manufacturers.	
12173	Ground Bone	Robert Manock, Rockville
12807	Mad River Pure Ground Bone	William McCormack, Wolcott
14021	Mad River Pure Ground Bone	William McCormack, Wolcott
	Sampled by Purchasers.	
12280	Ground Bone	Preston Fertilizer Co., Brooklyn, N. Y.
12282	Bone Meal	Milsom Rendering and Fertilizer Co., Buffalo, N. Y.
12118	Screenings from bone used in tempering steel	
12612	Ground Bone	Hartford Fertilizer Co., Hartford
12040	Western Ground Bone	Geo. F. Taylor & Co., N. Y. City
12041	Eastern Ground Bone	Geo. F. Taylor & Co., N. Y. City
12585	Ground Bone	Geo. F. Taylor & Co., N. Y. City

2. *Bone Manures Sampled by Manufacturers and by Purchasers.*

In the table just above are given analyses of seven samples of bone, which were sent by purchasers, and of two samples deposited by manufacturers representing brands which were not found in market by our sampling agent.

The Station is responsible for the correct subdivision and analysis of the small samples placed in its possession, but not for the accuracy with which those samples represent the several articles specified,—though it requires that a certificate be filed by the person drawing the sample, stating that it has been fairly drawn according to the printed directions furnished by the Station.

The valuation of **12807**, Mad River Bone, made by Wm. McCormack, was so low that the manufacturer asked to have a second sample analyzed, which was accordingly done. The second sample, **14021**, was like the first in mechanical condition, but contained smaller percentages of both nitrogen and phosphoric acid.

Sample **12118** represents screenings from bone prepared for

MANUFACTURERS AND PURCHASERS.

Sampled by	Dealer's cash price per ton.	Valuation per ton.	Percentage difference between cost and valuation.	Chemical Analysis.		Mechanical Analysis.	
				Nitrogen.	Phosphoric Acid.	Finer than 1-50 inch.	Coarser than 1-50 inch.
Manufacturer	$25.00	$23.45	6.6	4.39	20.81	2	98
Manufacturer	28.00	18.51	51.3	3.98	20.41	21	79
Manufacturer	28.00	16.20	72.8	3.59	17.20	22	78
O. G. Beard, Shelton	25.00	20.77	20.4	3.15	24.92	36	64
G. W. Barnes, Poquonock	28.00	21.37	31.0	3.18	20.72	62	38
Charles H. Wells, Suffield	----	16.04	----	2.92	16.75	39	61
C. J. Dewey, Buckland	----	----	----	2.81	26.35	--	--
A. E. Plant, Branford	----	26.74	----	3.29	25.98	75	25
A. E. Plant, Branford	----	----	----	2.43	28.57	--	--
A. E. Plant, Branford	----	23.63	----	3.77	23.27	55	45

use in tempering steel. It was a small lot bought for "from ten to twelve dollars" per ton.

On the Quantity of Fat in Several Brands of Bone Manures.

Determinations of fat have been made by Mr. Langley in a number of samples of bone manures, whose analyses are given in the table on pages 34-35, with the following results:

Station No.	Brand.	Percentage of Fat.
12371	Plumb & Winton's Bone Fertilizer	10.96
12414	Hubbard's Strictly Pure Fine Bone	9.34
12419	Rogers Mfg. Co.'s Pure Ground Bone	9.24
12424	Peck Bros. Pure Ground Bone	3.82
12559	Shay's Pure Bone Flour	3.62
12617	Manock's Ground Bone	3.44
12555	Dennis' Pure Ground Bone	3.39
12421	Shoemaker's Bone Meal	1.64
12315	Bowker's Ground Bone	1.46
12619	Frisbee's Pure Bone Meal	1.37
12893	Rogers Mfg. Co.'s Raw Bone Flour	0.73
12415	Downs & Griffins Ground Bone	0.49
12418	Rogers Mfg. Co.'s Bone	0.46
12416	Hubbard's Raw Knuckle Bone Flour	0.42
12368	Lederer & Co.'s Ground Bone	0.31

The three samples which contain over nine per cent. of fat probably represent butchers' bone with considerable adhering grease which has not been separated by boiling or steaming.

Of the four samples containing between three and four per cent. of fat, one at least is claimed by the manufacturer to be raw (untreated) bone.

Of those bones which have between one and two per cent. of fat, two samples at least have been subjected to treatment. Shoemaker's bone is treated by benzine, and Frisbee's is boiled or steamed to remove grease.

Of the five samples which contain less than one per cent. of fat, most have probably been steamed or boiled, but Hubbard's Raw Knuckle Bone Flour is claimed to be the refuse, trimmings and dust from selected hard raw bone used in the manufacture of articles of bone.

The quantity of grease in a raw bone, as these figures show, depends in the first place on the nature of the bone. The hard firm thigh and shin bones, from which the marrow has been

GROUND TANKAGE (☞)

Station No.	Name or Brand.	Manufacturer or Dealer.
	Sampled by Station Agent.	
12560	Ground Tankage	Williams & Clark Fertilizer Co., N. Y. City
12316	Tankage	Bowker Fertilizer Co., Boston, Mass.
12292	Blood, Bone and Meat	L. Sanderson, New Haven
12293	Pulverized Bone and Meat	L. Sanderson, New Haven
12291	Dried Blood and Meat	E. E. Burwell, New Haven
	Sampled by Purchasers.	
12170	Tankage	Berkshire Mills Co., Bridgeport
12268	Tankage	Bowker Fertilizer Co., Boston
12413	Blood, Bone and Meat	L. Sanderson, New Haven
12520	Pulverized Bone and Meat	Quinnipiac Co., Boston, Mass.
12522	Pulverized Bone and Meat	L. Sanderson, New Haven
12177	Tankage	

removed, may contain as little grease as much of the steamed or boiled butchers' bone. Softer bones, less carefully selected, with some adhering tissue, contain much more fat and raw, wet butchers' bone as it is collected from the market may contain, as appears on page 41 of the Report of this Station for 1898, over twenty per cent.

TANKAGE.

After boiling or steaming meat scrap, bone, and other slaughter-house waste, fat rises to the surface and is removed, the soup is run off, and the settlings are dried and sold as tankage. As analyses show, tankage has a very variable composition. In general, it contains more nitrogen and less phosphoric acid than bone.

In the table below, are given eleven analyses of this material, five drawn by a Station agent and six by purchasers.

These analyses show the usual differences in chemical composition.

ANALYSES AND VALUATIONS.

Sampled from Stock of	Dealer's cash price per ton.	Valuation per ton.	Percentage difference between cost and valuation.	Chemical Analysis.		Mechanical Analysis.	
				Nitrogen.	Phosphoric Acid.	Smaller than 1-50 inch.	Larger than 1-50 inch.
J. G. Schwink, Meriden	$22.00	$24.75	11.1*	7.43	8.56	69	31
F. B. Northam, East Hampton	24.00	25.63	6.4*	5.58	18.05	62	38
L. Sanderson, New Haven	28.00	24.99	12.0	6.33	13.69	65	35
L. Sanderson, New Haven	30.00	24.26	23.7	4.99	17.54	66	34
E. E. Burwell, New Haven	29.00	....	....	10.65	2.46	--	--
S. E. Curtis, Stratford	21.00	23.37	10.1*	6.38	12.91	53	47
F. T. Bradley, Saybrook	23.00	24.65	6.7*	7.82	9.30	53	47
Theodore Fowler, North Guilford	28.00	25.43	10.1	6.70	13.11	64	36
W. H. Brewer, Silver Lane	28.00	24.96	12.2	5.58	17.37	60	40
W. H. Brewer, Silver Lane	28.00	24.48	14.4	5.32	16.78	65	35
S. D. Woodruff & Sons, Orange	....	24.39	....	7.60	12.46	38	62

*Valuation exceeds cost.

No. **12291**, though tabulated with the samples of tankage, is, as the analysis indicates, largely composed of dried blood or meat with little bone.

DRY GROUND FISH.

This residue from the manufacture of fish oil is often sprinkled with diluted oil of vitriol, to check putrefaction, whereby the fish bones are softened and to some extent dissolved.

Eleven analyses of this article are given in the following table. With a single exception the percentage of nitrogen is well above the guarantee. In all but three cases the valuation exceeds cost; which indicates that dry fish has been, during the last season, a cheap source of available nitrogen and phosphoric acid.

DRY GROUND FISH. ANALYSES (☞)

Station No.	Manufacturer or Wholesale Dealer.	Sampled from Stock of	Dealer's Cash Price per Ton.
12360	Wilcox Fertilizer Works, Mystic	Ernest N. Austin, Suffield	$28.00
12548	L. Sanderson, New Haven	Wholesale Dealer	30.00
12487	Russia Cement Co., Gloucester, Mass.	F. S. Bidwell, Windsor Locks	30.00
		J. B. Parker, Jr., Poquonock	31.00
12549	W. E. Brightman, Tiverton, R. I.	William Crane, Broad Brook	28.00
12034	Geo. W. Miles, Agent, Milford	Manufacturer	28.00
12552	Williams & Clark Fertilizer Co., New York	Daniels Mills Co., Hartford	27.00
12622	L. Sanderson, successor to Luce Bros.	F. A. Beckwith, Niantic	28.00
12623	Wilcox Fertilizer Works, Mystic	C. M. Smith, East Hartford	32.00
		H. K. Brainard, Thompsonville	30.00
		Manufacturer	30.00
12550	Bowker Fertilizer Co., Boston	Bowker's Branch, Hartford	30.00
12566	Bradley Fertilizer Co., Boston	W. W. Cooper, Suffield	29.00
		S. J. Stevens, Glastonbury	32.00
12551	Quinnipiac Co., Hartford	Olds & Whipple, Hartford	32.00

MIXED FERTILIZERS.

Bone and Potash.

Six samples of this material have been analyzed with the results given in the following table, page 42.

12813, made by the Milsom Co., and **12656,** made by Lister's Agricultural Chemical Works, branded as bone and potash, are mixtures of dissolved phosphate and potash salts, but are not "bone and potash," in the usual proper acceptation of the term, and are therefore misbranded articles.

Samples **12375** and **12808** are the only ones which are not superphosphates, and appear to be mixtures of bone dust and potash salts. The phosphoric acid in **12375** is therefore valued as in bone.

12452. Dissolved Bone and Potash, made by the Darling Fertilizer Co.,Pawtucket, R. I. Sampled from stock of J. S. Warner, Glastonbury, and Hotchkiss & Templeton, Waterbury.

AND VALUATIONS.

Valuation per Ton.	Percentage Difference between Cost and Valuation.	Nitrogen.				Phosphoric Acid.						
		Nitrogen as Ammonia.	Nitrogen. Organic.	Total Nitrogen.		Soluble.	Reverted.	Insoluble.	Total.		Available.	
				Found.	Guaranteed.				Found.	Guaranteed.	Found.	Guaranteed.
	Valuation exceeds cost.											
$30.65	8.6	0.12	8.96	9.08	---	0.78	4.49	2.27	7.54	---	5.27	---
32.77	8.4	0.90	8.48	9.38	*7.4*	1.01	6.21	1.13	8.35	*9.0*	7.22	---
32.71	8.3	----	8.27	8.27	*8.0*	0.64	9.02	4.37	14.03	*11.0*	9.66	---
----	----	----	----	----	---	---	---	---	----	---	---	---
29.72	5.8	0.44	8.09	8.53	*7.4*	0.90	5.52	1.31	7.73	*7.0*	6.42	---
29.65	5.6	0.65	8.01	8.66	*6.6*	1.62	4.41	0.70	6.75	---	6.03	*8.0*
28.27	4.5	0.38	8.02	8.40	*7.4*	0.74	4.43	1.15	6.32	*7.0*	5.17	---
28.88	3.0	1.88	6.12	8.00	*8.2*	0.91	6.18	0.86	7.95	---	7.09	---
30.56	1.8	----	9.02	9.02	*8.5*	0.77	4.80	1.92	7.49	*6.0*	5.57	*4.0*
----	----	----	----	----	---	---	---	---	----	---	---	---
----	----	----	----	----	---	---	---	---	----	---	---	---
30.09	0.3	0.67	8.15	8.82	*8.0*	0.64	5.35	1.01	7.00	*6.0*	5.99	---
	Cost exceeds valuation.											
28.87	0.5	0.31	8.05	8.36	*7.4*	0.67	5.06	1.87	7.60	*7.0*	5.73	---
----	----	----	----	----	---	---	---	---	----	---	---	---
27.56	16.1	0.34	7.89	8.23	*7.4*	0.56	4.36	1.14	6.06	*7.0*	4.92	---

12625. Circle Brand Bone and Potash, made by Bradley Fertilizer Co., Boston. Sampled from stock of C. L. Comstock, Danbury.

12375. Square Brand Bone and Potash, made by Bowker Fertilizer Co., Boston. Sampled from stock of H. B. Sherwood, Southport, E. W. S. Pickett, Fairfield, and Hubbell & Bradley, Saugatuck.

12813. Bone and Dissolved Potash, made by the Milsom Fertilizer Co., East Buffalo, N. Y. Sampled from stock of C. H. Davis, Guilford.

12656. Animal Bone and Potash, made by Lister Agricultural Chemical Works, Newark, N. J. Sampled from stock of J. E. Leonard & Son, Jewett City.

12808. Bone and Potash, made by the E. F. Coe Fertilizer Co., N. Y. City. Sampled by the manufacturer.

Analyses and Valuations of Bone and Potash.

	12452	12625	12375	12813	12656	12808
Nitrogen as ammonia	0.24	0.10	----	----	----	----
Nitrogen, organic	1.77	2.47	1.80	----	----	3.03
Nitrogen, total	2.01	2.57	1.80	----	-- -	3.03
Nitrogen, guaranteed	1.50	1.85	1.50	----	----	----
Phosphoric acid, soluble	5.22	1.91	----	6.01	5.00	----
Phosphoric acid, reverted	9.69	8.30	----	4.41	3.98	----
Phosphoric acid, insoluble	0.28	5.80	----	0.51	1.91	----
Phosphoric acid, total	15.19	16.01	11.09	10.93	10.89	19.84
Phosphoric acid guaranteed	13.00	10.00	12.00	11.00	10.00	----
Available phosphoric acid found	14.91	10.21	----	10.42	8.98	----
Available phosphoric acid guaranteed	11.00	6.00	6.00	9.00	9.00	----
Potash as muriate	7.67	2.32	2.21	1.34	4.90	0.89
Potash as sulphate	----	----	----	----	----	1.88
Potash, total	7.67	2.32	2.21	1.34	4.90	2.77
Potash, guaranteed	7.00	2.00	2.00	1.65	5.00	----
Cost, per ton	$34.00	30.00	25.00	18.00	23.00	27.00
Valuation, per ton	$24.76	19.87	13.97	10.28	12.61	22.96
Percentage difference between cost and valuation	37.3	51.0	79.0	75.1	82.4	----

NITROGENOUS SUPERPHOSPHATES AND GUANOS.

Here are included those mixed fertilizers containing nitrogen, phosphoric acid, and in most cases, potash, which are not designed by their manufacturers for use on any special crop. "Special Manures" are noticed further on.

1. *Samples drawn by Station Agents.*

In the tables on pages 48 to 61 are given analyses of 117 samples belonging to this class, arranged according to the percentage differences between their cost prices and valuations.

Guarantees.

Of the one hundred and seventeen analyses of nitrogenous superphosphates given in the tables, eighteen are below the manufacturer's minimum guarantee in respect of one ingredient and ten in respect of two ingredients. Nearly one-fourth of the whole number therefore failed in some respect to come up to the claims of the manufacturer.

It should be said, however, that a deficiency of one ingredient is sometimes attended with a marked excess of another, indicating that failure to correspond with the guarantee has been caused by incomplete mixing of the materials, of which the superphosphate is made up.

Cost and Valuation.

Cost.

The method used to ascertain the retail cost price of the superphosphates is as follows:

The sampling agents inquire and note the price at the time each sample is drawn. The analysis, when done, is reported to each dealer from whom a sample was taken, with an enclosed postal card addressed to the Station, and a request to note on it whether the retail cash price is correctly given and to mail to the Station.

From the data thus obtained the average prices are computed.

Valuation.

The valuation has been computed in all cases in the usual manner as explained on page 18.

Percentage difference given in the table shows the percentage excess of the cost price over the average retail cost of the nitrogen, phosphoric acid, and potash contained in the fertilizer.

This information enables the purchaser to estimate the comparative value of different brands and to determine whether it is better economy to buy the commercial mixed fertilizers of which so many are now offered for sale, or to purchase and mix for himself the raw materials.

Which plan is preferable can only be determined by each individual farmer, who should know best what his soil and crops need and what his facilities for purchase and payment are.

In case a fertilizer has sold at two or more different prices, the *manufacturer's price,* when known, has been used in calculating percentage difference.

Otherwise an *average, or nearly average price,* forms the basis of comparison between cost and valuation. The price thus employed is printed in heavy-faced type.

The average cost of the nitrogenous superphosphates is $29.54. The average valuation is $19.55 and the percentage difference 51.1.

Last year the corresponding figures were:

Average cost $29.22, average valuation $19.30, percentage difference 51.4.

These valuations, it must be remembered, are based on the assumption that the nitrogen, phosphoric acid, and potash in each fertilizer are of good quality and readily available to farm crops. Chemical examination shows conclusively whether this is true in respect of potash and phosphoric acid, but gives little or no clue as to the availability of the organic nitrogen of mixed goods. This Station has been for some years, and is still, engaged in a study of methods for determining approximately the relative availability of nitrogen.

Since various inferior or agriculturally worthless forms of nitrogen are in the market and are known to be used in compounding fertilizers, and cannot as yet be detected with certainty by analysis, the only security of purchasers of mixed fertilizers is in dealing with firms which have the highest reputation and are able to satisfy their customers that they use the best raw materials, and in avoiding "cheap" goods offered by irresponsible parties.

In the tables the various brands of nitrogenous superphosphates are arranged according to the percentage excess of selling price over valuation; those brands being given first in which valuation approaches nearest to cost.

The assertion of interested parties that valuation is useless because little or no clue to the availability of the organic nitrogen of mixed goods can be found by chemical analysis, may be briefly noticed.

That the valuation always shows the fair selling price of fertilizers is expressly disclaimed by the Station.

But it is true that the valuation sums up in a single statement certain facts which are shown in the chemical analysis by a considerable number of figures, and enables the purchaser to make a comparison of the *probable values* of any number of fertilizers which otherwise defy all attempts at comparison.

To illustrate: Below are given the average composition and valuation of the nineteen superphosphates (the number on the first manuscript page of the table) which begin the table on pages 48 to 61 which we may call lot A, and also seventeen analyses (the number on the last manuscript page but one of the table) which are near the foot of the table, numbers **12587** to **12643**, and which we may call lot B.

As it happens, the average cost price of both lots is the same and the valuations differ by about $7.50.

AVERAGE COMPOSITION OF NITROGENOUS SUPERPHOSPHATES.

LOT A AND LOT B.

	"Lot A."	"Lot B."
Nitrogen as nitrates	0.48	0.13
" ammonia	0.18	0.01
" organic	2.45	1.74
Soluble phosphoric acid	5.88	5.43
Reverted " "	3.42	3.71
Insoluble " "	1.01	1.78
Potash as muriate	3.93	1.94
" sulphate	2.10	0.36
Cost per ton	$28.15	$28.15
Valuation per ton	23.31	15.88

Now unless some of the firms whose brands are included in lot A are dishonestly selling inferior forms of nitrogen, while all of those whose brands are included in lot B are using only

the good, readily available forms of nitrogen, the relative value of these two lots of fertilizers is fairly expressed by the figures 23.31 and 15.88.

A mixture containing the same quantities of nitrogen, available phosphoric acid and potash as the average of lot A could be made of 61 pounds of nitrate, 17 of sulphate of ammonia, 700 of cotton seed meal, 1330 of acid phosphate, 158 of muriate and 90 of high grade sulphate of potash.

Calling the ton cost of these articles, $45 for nitrate, $70 for sulphate of ammonia, $23.00 for cotton seed meal, $15.00 for acid phosphate, $42.50 for muriate and $50 for high grade sulphate of potash (higher figures than have been paid by retail purchasers of these articles during the last season), we find that the mixture, weighing 2,356 pounds and costing $25.60, contains the same amount of available plant food as the factory mixture weighing 2,000 pounds and costing, *mixed and bagged,* $28.15. Evidently *at the prices quoted for fertilizer-chemicals,* these particular factory-mixed goods will be a little cheaper than the home-mixed if the latter is made from the materials named.

On the other hand, 17 pounds of nitrate of soda, 500 of cotton seed meal, 1,300 of acid phosphate, 78 of muriate of potash and 15 of sulphate of potash will contain as much available plant food as two thousand pounds, like the average of lot B.

The total weight will be 1,910 pounds and the cost of the goods unmixed $17.88.

The relative value of the two lots of fertilizers as reckoned from the average valuations is 100 to 68: as calculated from the cost of raw materials necessary to furnish the same quantities of plant food, the relative value is 100 to 70.

It does not follow that one fertilizer is more economical than another because its valuation is a dollar or two higher or the percentage difference between cost and valuation slightly lower, but it is a fact that when costly fertilizers are made of the best materials, the valuations fairly express their *relative commercial values,* and are the best and only safe guide that the purchaser can employ.

It requires no argument to make plain that while it is very possible or even probable that a fertilizer may be worth less than the Station valuation, it is extremely improbable that it

can be worth more than that valuation, except as a result of a considerable advance in the cost of raw materials or of labor, subsequent to the time of determining trade values, in March of each year.

On the other hand, the consumer can always guard his own interests by refusing to purchase those articles which show a great percentage difference between cost and valuation.

Analyses Requiring Special Notice.

12454, Fairfield's Formula for Corn and General Crops, is a mixture of nitrate of soda, bone and muriate of potash and not a nitrogenous superphosphate. It contains 55 per cent. of bone graded as "fine," *i. e.*, passing a sieve with circular holes $^1/_{50}$ inch in diameter, and 45 per cent. of bone which does not pass the sieve.

12351. Shoemaker's Swift Sure Superphosphate. This analysis was unsatisfactory to the manufacturers, because it showed 0.4 per cent. less of nitrogen, a quarter of one per cent. less of potash and a per cent. and a half more of available phosphoric acid than their own tests led them to believe the goods contained. But more important that this, the manufacturers claim to use *only* high grade sulphate of potash, whereas our analysis showed some muriate. Two other samples of the goods were accordingly drawn and analyzed with the result given on pages 52 and 53 of the table. The composition of these samples is about what was claimed by the manufacturer.

12577. Erie King, made by the Milsom Rendering & Fertilizer Co., Buffalo, N. Y. As the analysis of this sample did not correspond with the manufacturer's guarantee, the Station was asked to draw and analyze other samples, but was unable, after the request was made, to find the brand on sale in the State.

12603. Bay State Special, made by H. F. Tucker Co., Boston. The manufacturer stated that the analysis did not represent the average quality of this brand and asked that samples be drawn from stock of other dealers. The sampling agent could not find the goods on sale at the time by any one except the dealer from whom this sample had been taken.

But at the request of the manufacturer a second sample was drawn from the stock of Mr. Schneider and analyzed, with the results given on page 55, No. **12799.**

NITROGENOUS SUPERPHOSPHATES. SAMPLED BY THE STATION.

Station No.	Name of Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
12380	Bone, Fish and Potash	E. R. Kelsey, Branford	F. H. Rolf, Guilford	$20.00	$21.24
			Samuel Foote, Branford	20.00	----
12349	XX Formula	C. Buckingham, Southport	E. B. Clark Co., Milford	-----	27.50
			Manufacturer	30.00	----
12579	Manchester's Formula	E. Manchester & Sons, W. Winsted	Manufacturer	29.00	25.41
12425	C. V. O. Co's Fertilizer	Conn. Valley Orchard Co., Berlin	J. L. Watrous, Meriden	26.00	22.70
12474	Superphosphate	E. E. Burwell, New Haven	Manufacturer	28.00	24.03
12500	Complete Fertilizer	F. E. Boardman, Little River	Manufacturer	28.00	23.48
12634	Bone, Fish and Potash	L. Sanderson, New Haven, successor to Luce Bros., Niantic	M. A. Tucker, Chesterfield	25.00	20.55
12497	A. A. Complete Manure	Crocker Fert. & Chem. Co., Buffalo, N. Y.	C. F. Tallard & Son, Broad Brook	32.00	24.48
			S. E. Dowd, Clinton	28.00	----
				30.00	
12575	Complete Manure	Standard Fertilizer Co., Boston	R. E. Hyde, Ellington	30.00	24.40
12509	Middlesex Special	Bowker Fertilizer Co., Boston	Baldwin's Mills, Meriden	25.00	20.29
12035	I. X. L. Ammoniated Bone Superphosphate	Geo. W. Miles, Agent, Milford	Manufacturer	22.00	17.82
12400	Essex Fish and Potash	Russia Cement Co., Gloucester, Mass.	E. N. Pierce & Co., Plainville	28.00	21.86
			A. R. Manning & Co., Yantic	27.00	----
12581	Market Garden	Lowell Fertilizer Co., Boston	H. A. Bugbee, Willimantic	34.00	26.89
12608	"Ceres" Special Complete Fertilizer	G. W. Miles, Agent, Milford	Manufacturer	30.00	23.50
12597	Berkshire Complete Fertilizer	Berkshire Mills Co., Bridgeport	Manufacturer.	30.00	23.46
12314	Dissolved Bone	Mapes F. & P. G. Co., New York	Mapes Branch, Hartford	29.00	22.60
12633	Frisbie's Superphosphate	L. T. Frisbie Co., Hartford	City Coal and Wood Co., New Britain	33.00	25.69
12669	All Round Fertilizer	Rogers Mfg. Co., Rockfall	Manufacturer	23.00	17.88
12435	Bowker's Market Garden Fertilizer	Bowker Fertilizer Co., Boston	A. L. Hitchcock, Plainville	34.00	24.70
			H. B. Sherwood, Southport	32.00	----
12481	Blood, Bone and Potash	L. B. Darling Fertilizer Co., Pawtucket, R. I.	W. W. Cooper, Suffield.	34.00	25.91
			Hotchkiss & Templeton, Waterbury	36.00	----

Analyses and Valuations.

Station No.	Percentage difference between cost and valuation.	Nitrogen					Phosphoric Acid.							Potash.		
		*Nitrogen as Nitrates.	Nitrogen as Ammonia.	Nitrogen Organic.	Total Nitrogen		Soluble.	Reverted.	Insoluble.	Total.		Available.		Found.		Guaranteed.
					Found.	Guaranteed.				Found.	Guaranteed.	Found.	Guaranteed.	As Muriate.	Total.	
12380	5.8*	----	0.69	3.34	4.03	*3.1*	3.55	2.35	0.39	6.29	*4.0*	5.90	----	0.73	4.69	*4.0*
12349	9.1	1.67	----	2.44	4.11	*5.0*	6.46	3.76	1.37	11.59	*10.0*	10.22	*5.0*	3.43	7.63	*8.0*
12579	14.1	0.64	----	3.26	3.90	*3.5*	6.03	2.47	0.54	9.04	*7.5*	8.50	----	2.71	7.46	*8.0*
12425	14.5	1.71	----	2.48	4.19	*4.1*	5.20	4.33	1.69	11.22	----	9.53	*9.0*	3.13	3.13	*3.0*
12474	16.5	1.82	----	1.53	3.35	----	5.94	1.43	0.31	7.68	----	7.37	----	1.09	8.75	----
12500	19.3	----	----	2.80	2.80	*2.5*	6.38	2.03	0.20	8.61	----	8.41	*8.0*	9.65	9.65	*10.0*
12634	21.7	----	0.90	2.44	3.34	*3.0*	2.33	3.26	0.31	5.90	*4.0*	5.59	----	0.53	6.27	*4.0*
12497	22.5	----	----	3.36	3.36	*3.3*	6.64	3.79	1.38	11.81	----	10.43	*8.0*	5.97	6.41	*7.6*
12575	23.0	0.66	----	2.94	3.60	*3.3*	6.24	3.43	0.90	10.57	*9.0*	9.67	*8.0*	6.82	6.82	*7.0*
12509	23.2	0.26	----	2.05	2.31	*2.1*	6.59	3.07	0.46	10.12	*8.0*	9.66	----	6.27	6.27	*6.0*
12035	23.5	0.14	0.75	1.96	2.85	*2.1*	5.89	1.11	4.32	11.32	----	7.00	*8.0*	2.13	2.13	*2.0*
12400	23.5	0.32	----	2.55	2.87	*2.1*	7.04	5.80	1.87	14.71	*12.0*	12.84	----	2.58	2.58	*2.3*
12581	26.4	----	0.35	4.54	4.89	*4.1*	7.01	0.69	0.13	7.83	*8.0*	7.70	*7.0*	0.48	6.29	*6.0*
12608	27.7	0.69	0.49	1.95	3.13	*3.3*	5.28	3.74	0.92	9.94	*10.0*	9.02	*8.0*	0.53	6.81	*7.0*
12597	27.9	0.75	----	1.81	2.56	*2.5*	8.64	2.88	1.20	12.72	*10.0*	11.52	*8.0*	0.44	6.02	*6.0*
12314	28.3	----	----	3.08	3.08	*2.1*	7.71	8.43	0.76	16.90	*12.0*	16.14	----	----	----	----
12633	28.5	0.16	---	3.70	3.86	*3.3*	6.82	2.84	0.68	10.34	*11.5*	9.66	*11.0*	7.35	7.35	*8.0*
12669	28.6	----	----	1.67	1.67	*1.6*	5.41	6.08	1.17	12.66	*10.0*	11.49	----	3.53	3.53	*2.0*
12435	29.6	0.30	----	2.45	2.75	*2.3*	5.30	3.14	1.67	10.11	*7.0*	8.44	*6.0*	10.75	10.75	*10.0*
12481	31.2	0.82	0.24	2.98	4.04	*4.1*	5.97	3.20	0.16	9.33	*8.0*	9.17	*7.0*	8.01	8.01	*7.5*

* Valuation exceeds cost.

NITROGENOUS SUPERPHOSPHATES. SAMPLED BY THE STATION.

Station No.	Name of Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
12426	Hubbard's Fertilizer for all soils and all crops	Rogers & Hubbard Co., Middletown	H. W. Andrews, Wallingford	$28.00	$21.21
			Wells & Dean, Bloomfield	27.00	----
12329	Vegetable Manure, or Complete Manure for Light Soils	Mapes F. & P. G. Co., New York	Birdsey & Foster, Meriden	40.00	29.16
			Mapes Branch, Hartford	39.00	----
12464	Ammoniated Bone with Potash	Armour Fertilizer Works, Chicago	C. J. Benham, New Haven	26.00	20.92
			E. A. Buck & Co., Willimantic	30.00	----
				28.00	
12644	Pequot Fish and Potash	Quinnipiac Co., Boston	A. I. Martin, Wallingford	22.00	16.39
12033	"Ceres" Special Complete	G. W. Miles, Agt., Milford	Manufacturer	30.00	22.30
12454*	Fairchild's Formula for Corn and General Crops	Rogers & Hubbard Co., Middletown	H. W. Andrews, Wallingford	45.00	33.19
			W. C. Buckley, Forestville	45.00	----
			Manufacturer	45.00	----
12510	All Soluble	Armour Fertilizer Works, Chicago	C. J. Benham, New Haven	32.00	23.59
12451	Farm Favorite	L. B. Darling Fertilizer Co., Pawtucket, R. I.	J. S. Warner, Glastonbury	28.00	20.64
			Hotchkiss & Templeton, Waterbury	30.00	----
			Lewis Ford, Norwich	28.00	----
12333	Average Soil Complete Manure	Mapes F. & P. G. Co., New York	Birdsey & Foster, Meriden	34.00	24.21
			Mapes Branch, Hartford	33.00	----
12594	High Grade Fish and Potash	Wilcox Fertilizer Works, Mystic	Lewis Ford, Norwich	30.00	20.51
			Manufacturer	28.00	----
12538	Garden Special	Great Eastern Fertilizer Co., Rutland	Silas Finch, Greenwich	32.00	23.21
12387	Gardeners Complete Manure	Packer's Union Fertilizer Co., New York	O. S. Rogers, Essex	36.00	25.33
			Nelson Dayton, New London	35.00	----
12391	Concentrated Phosphate	Cumberland Bone-Phosphate Co., Boston	Kahn Bros., Yantic	30.00	23.48
			D. C. Spencer, Saybrook	35.00	----
				32.50	----
12373	Ammoniated Bone Phosphate	National Fertilizer Co., Bridgeport	Manufacturer	----	20.86
			Ansonia Flour and Feed Co., Ansonia	30.00	----
			Gault Bros., Westport	28.00	----
				29.00	

* See page 47.

Analyses and Valuations—*Continued.*

Station No.	Percentage difference between cost and valuation.	Nitrogen					Phosphoric Acid.							Potash.		
		Nitrogen as Nitrates.	Nitrogen as Ammonia.	Nitrogen Organic.	Total Nitrogen.		Soluble.	Reverted.	Insoluble.	Total.		Available.		Found.		Guaranteed.
					Found.	Guaranteed.				Found.	Guaranteed.	Found.	Guaranteed.	As Muriate.	Total.	
12426	32.0	1.00	....	1.79	2.79	*2.3*	7.89	3.57	1.31	12.77	*12.0*	11.46	*10.0*	3.79	3.79	*3.0*
12329	33.7	2.57	.67	2.23	5.47	*4.9*	2.46	4.87	1.25	8.58	*8.0*	7.33	*6.0*	1.13	8.04	*6.0*
12464	33.8	....	....	3.17	3.17	*2.5*	2.72	5.67	4.11	12.50	*8.0*	8.39	*6.0*	0.83	3.53	*2.0*
12644	34.2	....	.47	2.41	2.88	*2.1*	2.38	4.04	2.90	9.32	*7.0*	6.42	*6.0*	2.00	2.00	*2.0*
12033	34.5	.71	.78	2.05	3.54	*3.1*	5.42	1.09	2.88	9.39	....	6.51	*7.0*	.79	5.66	*6.0*
12454*	35.6	3.27	....	2.01	5.28	*5.5*	....	....	....	12.49	*12.0*	....	....	14.55	14.55	*12.5*
12510	35.7	....	.78	2.40	3.18	*2.9*	2.50	6.92	1.21	10.63	*10.0*	9.42	*8.0*	0.11	6.28	*4.0*
12451	35.7	....	.18	2.20	2.38	*2.1*	7.79	2.99	.49	11.27	*9.0*	10.78	*7.0*	5.10	5.10	*5.0*
12333	36.3	2.88	....	1.57	4.45	*4.1*	4.45	2.88	.76	8.09	*8.0*	7.33	*7.0*	0.96	6.14	*5.0*
12594	36.5	....	.30	3.62	3.92	*3.3*	3.84	2.07	.46	6.37	*6.0*	5.91	*5.0*	4.91	4.91	*4.0*
12538	37.9	.44	....	3.05	3.49	*3.3*	4.90	2.40	.89	8.19	....	7.30	*6.0*	8.09	8.09	*8.0*
12387	38.2	.86	....	1.92	2.78	*2.5*	7.38	1.50	.48	9.36	....	8.88	*8.0*	0.95	9.91	*10.0*
12391	38.4	.75	....	2.53	3.28	*3.3*	5.84	3.36	1.64	10.84	*10.0*	9.20	*8.0*	6.95	6.95	*7.0*
12373	39.0	....	.36	1.73	2.09	*1.9*	2.11	7.83	1.18	11.12	*9.0*	9.94	*7.0*	2.42	2.42	*2.0*

NITROGENOUS SUPERPHOSPHATES. SAMPLED BY THE STATION.

Station No.	Name of Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
12592	Soluble Potato and General Crop	Rogers Mfg. Co., Rockfall	R. H. Hall, East Hampton	$38.00	$27.28
			Manufacturer	38.00	----
12404	Superior Truck Fertilizer	M. E. Wheeler & Co., Rutland, Vt.	D. G. Chesebro, Center Groton	32.00	22.71
			J. F. Blakeslee, North Haven	38.00	----
12816	Chittenden's Fish and Potash	National Fertilizer Co., Bridgeport	G. & A. H. Williams, E. Hartford	30.00	21.11
			Manufacturer	----	----
12641	High Grade Farmer's Friend	Read Fertilizer Co., New York	T. A. Tillinghast, Brooklyn	36.00	25.31
12532†	Superphosphate	M. L. Shoemaker & Co., Philadelphia	Olds & Whipple, Hartford	35.00	24.58
12628†	Shoemaker's Swift Sure Superphosphate	M. L. Shoemaker & Co., Philadelphia	Olds & Whipple, Hartford	35.00	24.46
12209	Standard Complete Manure	Standard Fertilizer Co., Boston	H. F. Child, Woodstock	34.00	23.72
12386	Market Garden Manure	Quinnipiac Co., Boston	G. W. Williams Co., New London	38.00	24.27
			C. Buckingham, Southport	30.00	----
				35.00	
12578	Triangle A. Fish and Potash	Bradley Fertilizer Co., Boston	C. S. Gillette, Cheshire	28.00	19.37
12632	Old Reliable Superphosphate	L. Sanderson, New Haven	Manufacturer	28.00	19.33
			A. B. Morse, Guilford	30.00	----
12536	Animal Brand Fertilizer	Lowell Fertilizer Co., Boston	F. S. Bidwell, Windsor Locks	28.00	19.31
			J. D. Beasley, Ellington	28.00	----
			Balch & Platt. W. Winsted	33.00	----
12517	Eclipse Phosphate	Bradley Fertilizer Co., Boston	W. W. Sheldon, South Woodstock	27.00	18.54
12599	Cecrops Fertilizer	Fred'k Ludlam, New York	S. A. Smith, Clintonville	34.00	23.31
12574	High Grade Complete Manure	Cleveland Dryer Co., Boston	C. O. Dart, Vernon Center	35.00	23.99
12351†	Shoemaker's Swift Sure Superphosphate	M. L. Shoemaker & Co., Philadelphia	E. B. Clark Co., Milford	33.00	23.78
			Gault Bros., Westport	36.00	----
				35.00	
12494	High Grade Special	Williams & Clark Fertilizer Co., N. Y.	B. F. Pinney, Ellington	35.00	23.76
			T. B. Atwater, Plantsville	37.00	----
12646	Great Planet A. A.	Clark's Cove Fertilizer Co., New York	H. P. Treat, Orange	----	23.64
				35.00	
12593	Complete Bone Superphosphate	Wilcox Fertilizer Works, Mystic	Lewis Ford, Norwich	28.00	----
			Manufacturer	28.00	18.83

† See page 47.

ANALYSES AND VALUATIONS—*Continued.*

Station No.	Percentage difference between cost and valuation.	NITROGEN.					PHOSPHORIC ACID.							POTASH.		
		Nitrogen as Nitrates.	Nitrogen as Ammonia.	Nitrogen Organic.	Total Nitrogen. Found.	Total Nitrogen. Guaranteed.	Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Found. As Muriate.	Found. Total.	Guaranteed.
12592	39.3	.72	.47	2.46	3.65	*3.5*	1.62	6.59	1.74	9.95	*9.0*	8.21	----	.93	9.89	*8.8*
12404	40.9	.20	----	2.88	3.08	*3.3*	4.93	3.15	1.46	9.54	----	8.08	*7.0*	7.78	7.78	*8.0*
12816	42.1	----	----	2.89	2.89	*3.0*	5.95	2.67	1.23	9.85	*6.0*	8.62	----	.27	5.07	*4.0*
12641	42.2	----	----	3.46	3.46	*3.3*	3.02	3.40	1.24	7.66	----	6.42	*5.0*	11.39	11.39	*10.0*
12532†	42.4	.94	----	1.96	2.90	*2.5*	9.31	3.87	1.03	14.21	----	13.18	*9.0*	1.76	5.11	*4.0*
12628†	43.1	.93	----	2.07	3.00	*2.5*	8.40	4.15	1.75	14.30	----	12.55	*9.0*	.71	4.86	*4.0*
12209	43.3	.24	----	2.98	3.22	*3.3*	6.40	1.88	1.21	9.49	*9.0*	8.28	*8.0*	8.28	8.28	*7.0*
12386	44.2	1.21	.15	2.21	3.57	*3.3*	5.04	4.22	1.32	10.58	*9.0*	9.26	*8.0*	6.16	7.07	*7.0*
12578	44.6	.20	.13	1.67	2.00	*2.0*	2.13	4.34	3.74	10.21	*6.0*	6.47	----	8.13	8.13	*5.0*
12632	44.9	.14	----	2.73	2.87	*2.5*	2.20	6.04	3.96	12.20	*10.0*	8.24	*7.0*	3.47	3.47	*2.0*
12536	45.0	----	----	2.58	2.58	*2.5*	7.81	1.49	.77	10.07	*10.0*	9.30	*8.0*	4.19	4.19	*4.0*
12517	45.6	.31	----	1.77	2.08	*1.0*	5.81	5.22	2.50	13.53	*12.0*	11.03	*10.0*	2.81	2.81	*1.5*
12599	45.9	1.76	----	1.85	3.61	*3.0*	6.27	2.10	1.22	9.59	----	8.37	*7.0*	6.96	6.96	*7.0*
12574	45.9	.75	----	2.59	3.34	*3.3*	5.30	3.46	2.01	10.77	*9.0*	8.76	*8.0*	7.67	7.67	*7.0*
12351†	47.2	.89	----	1.89	2.78	*2.5*	9.23	3.56	2.01	14.80	----	12.79	*9.0*	3.29	4.79	*4.0*
12494	47.3	.73	----	2.69	3.42	*3.3*	4.93	4.23	1.68	10.84	*9.0*	9.16	*8.0*	6.95	6.95	*7.0*
12646	48.1	.75	.38	2.28	3.41	*3.3*	3.87	5.06	1.64	10.57	*9.0*	8.93	*8.0*	7.12	7.12	*7.0*
12593	48.7	.07	.32	2.15	2.54	*2.0*	2.77	5.66	3.72	12.15	*9.0*	8.43	*8.0*	3.72	3.72	*3.0*

† See page 47.

NITROGENOUS SUPERPHOSPHATES. SAMPLED BY THE STATION.

Station No.	Name of Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
12338	Formula A	L. Sanderson, New Haven	Manufacturer	$35.00	$23.49
			†Sidney B. Smith, East Haven	31.00	----
12542	Complete for General Use	East India Chemical Works, H. J. Baker & Bros., New York	C. F. Tallard & Son, Broad Brook	33.00	21.90
12635	Special with 10 per cent. Potash	L. Sanderson, New Haven	A. B. Morse, Guilford	35.00	23.08
			Ives Brothers, West Cheshire	35.00	----
12629	Americus High Grade Special	Williams & Clark Fertilizer Co., N. Y.	Gault Bros., Westport	36.00	23.71
12348	Fisherman's Brand Fish and Potash	Bowker Fertilizer Co., Boston	J. F. Buckhout, Greenwich	26.00	16.45
			Bowker's Branch, Hartford	25.00	----
12491	Square Brand Fish and Potash	Bowker Fertilizer Co., Boston	City Coal & Wood Co., New Britain	26.00	17.07
			E. F. Miller, Ellington	26.00	----
12664	Gold Brand Excelsior Guano	E. Frank Coe Co., New York	W. D. Wanzer, Lanesville	33.00	21.66
12799	*Bay State Special	H. F. Tucker Co., Boston	Alfred Schneider, Rockville	32.00	22.90
			C. J. Goodale, Glastonbury	32.00	----
				35.00	----
12814	Market Garden Fertilizer	National Fertilizer Co., Bridgeport	Manufacturer	32.00	20.93
12374	Complete Fertilizer	National Fertilizer Co., Bridgeport	Manufacturer	-----	----
			J. F. Buckhout, Greenwich	37.00	24.01
12603	*Bay State Special Fertilizer	H. F. Tucker Co., Boston	C. J. Goodale, Glastonbury	37.00	22.71
				35.00	----
12651	B. B. Guano	Milsom Rend. & Fert. Co., East Buffalo, N.Y.	E. A. Halladay, Suffield	16.00	10.35
12537	Keystone Bone Phosphate	S. M. Hess & Bro., Philadelphia	M. S. Treat, Woodmont	20.00	12.93
			C. I. Pheeland, W. Suffield	25.00	----
12486	Vegetable Bone Fertilizer	Milsom Rend. & Fert. Co., East Buffalo, N.Y.	G. W. Barnes, Poquonock	37.00	22.56
			Chas. H. Davis, Guilford	35.00	----
12396	Fish and Potash	Rogers Mfg. Co., Rockfall	A. J. Palmer, Branford	28.00	17.96
			D. W. Spencer, Centerbrook	28.00	----
12511	Bowker's Hill and Drill Phosphate	Bowker Fertilizer Co., Boston	H. B. Sherwood, Southport	30.00	19.15
12469	Americus Ammoniated Bone Superphosphate	Williams & Clark Fertilizer Co., N. Y.	J. G. Schwink, Meriden	29.00	18.36
			R. B. Witter, Brooklyn	-----	----
12659	Standard Pure Bone Superphosphate of Lime	Lister's Agricultural Chemical Works, Newark, N. J.	A. N. Clark, Milford	28.00	17.71

† Consumer, not a dealer.

* See page 47.

ANALYSES AND VALUATIONS—*Continued.*

Station No.	Percentage difference between cost and valuation.	NITROGEN.					PHOSPHORIC ACID.							POTASH.		
		Nitrogen as Nitrates.	Nitrogen as Ammonia.	Nitrogen Organic.	Total Nitrogen.		Soluble.	Reverted.	Insoluble.	Total.		Available.		Found.		Guaranteed.
					Found.	Guaranteed.				Found.	Guaranteed.	Found.	Guaranteed.	As Muriate.	Total.	
12338	49.0	1.02	....	2.71	3.73	*3.1*	4.03	3.73	2.08	9.84	*10.0*	7.76	*6.0*	6.95	6.95	*6.0*
12542	50.7	.32	.73	1.71	2.76	*2.2*	5.73	2.93	.96	9.62	*9.0*	8.66	*8.0*	7.34	7.34	*6.0*
12635	51.6	....	....	2.79	2.79	*2.5*	2.93	4.39	2.41	9.73	*9.0*	7.32	*5.0*	9.60	9.60	*10.0*
12629	51.8	.63	.68	2.19	3.50	*3.3*	1.13	7.90	1.87	10.90	*9.0*	9.03	*8.0*	6.90	6.90	*7.0*
12348	52.0	....	.17	2.29	2.46	*2.3*	3.50	1.66	1.42	6.58	*6.0*	5.16	*4.0*	5.27	5.27	*5.0*
12491	52.3	....	.42	2.10	2.52	*2.3*	3.26	3.46	1.28	8.00	*8.0*	6.72	....	4.37	4.37	*4.0*
12664	52.4	.33	....	2.24	2.57	*2.0*	5.62	2.29	1.87	9.78	*9.0*	7.91	*8.0*	.60	7.01	*6.0*
12799	52.8	.68	.11	2.32	3.11	*3.3*	5.28	4.41	1.90	11.59	*11.0*	9.69	*8.0*	6.27	6.27	*7.0*
12814	52.9	....	.60	2.18	2.78	*2.5*	4.40	4.63	1.11	10.14	*9.0*	9.03	*7.0*	5.80	5.80	*6.0*
12374	54.1	....	.80	2.98	3.78	*3.3*	6.46	2.11	1.00	9.57	*10.0*	8.57	*8.0*	4.73	6.08	*10.0*
12603	54.1	.72	....	2.46	3.18	*3.3*	5.96	3.15	1.70	10.81	*9.0*	9.11	*8.0*	6.42	6.42	*7.0*
12651	54.6	....	.12	1.73	1.85	*1.8*	1.79	2.70	1.25	5.74	*6.0*	4.49	*5.0*	1.03	1.03	*2.0*
12537	54.7	....	....	1.14	1.14	*0.8*	1.07	9.22	1.29	11.58	....	10.29	*9.0*	1.04	1.04	*1.0*
12486	55.1	....	....	3.81	3.81	*4.1*	5.60	2.31	2.11	10.02	*9.0*	7.91	*8.0*	4.89	4.89	*5.0*
12396	55.9	....	.36	3.03	3.39	*3.3*	.64	3.77	3.44	7.85	*6.0*	4.41	....	4.02	4.02	*3.8*
12511	56.7	.38	....	2.28	2.66	*2.3*	7.06	3.75	1.60	12.41	*12.0*	10.81	*9.0*	2.15	2.15	*2.0*
12469	58.0	.21	....	2.41	2.62	*2.5*	5.62	4.40	1.88	11.90	*10.0*	10.02	*9.0*	2.06	2.06	*2.0*
12659	58.1	....	.34	1.81	2.15	*2.4*	7.80	2.70	2.45	12.95	*12.0*	10.50	*10.0*	1.72	1.72	*1.5*

NITROGENOUS SUPERPHOSPHATES. SAMPLED BY THE STATION.

Station No.	Name of Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
12411	A. Brand Manure	Mapes F. & P. G. Co., New York	Southington Lumber & Feed Co., Southington	$31.00	$20.69
			W. C. Bulkley, Forestville	34.00	----
			Birdsey & Foster, Meriden	**33.00**	----
12492	Harvest Home Phosphate	East India Chemical Works, H. J. Baker & Bros., Props., New York	Carlos Bradley, Ellington	22.00	15.02
			F. S. Platt, New Haven	30.00	----
				24.00	----
12463	Universal Fertilizer	Packer's Union, New York	Nelson Dayton, New London	**25.00**	15.53
			J. P. Little, Columbia	26.00	----
12346	Patent Superphosphate	Bradley Fertilizer Co., Boston	C. O. Jelliff & Co., Southport	**30.00**	18.56
			Kinsella & Smallhorn, New Canaan	32.00	----
			D. L. Clark, Milford	30.00	----
12667	Ammoniated Bone and Potash	W. E. Brightman, Tiverton, R. I.	William Crane, Broad Brook	**30.00**	18.48
12467	General Fertilizer	Great Eastern Fertilizer Co., Rutland, Vt.	T. E. Greene, Plainfield	26.00	15.30
			H. S. Harvey, Windham	**25.00**	----
12543	Hawkeye Fertilizer	Cumberland Bone-Phosphate Co., Boston	Kahn Bros., Yantic	**20.00**	12.13
12657	Success Fertilizer	Lister's Agric. Chem. Works, Newark, N. J.	A. N. Clark, Milford	**25.00**	15.14
12448	Farmers' New Method Fertilizer	Bradley Fertilizer Co., Boston	D. L. Clark, Milford	**28.00**	16.88
			Wilson & Burr, Middletown	28.00	----
12508	Bone and Wood Ash Fertilizer	Bowker Fertilizer Co., Boston	A. L. Hitchcock, Plainville	**26.00**	15.61
12385	Phosphate	Quinnipiac Co., Boston	Gault Bros., Westport	32.00	18.51
			G. W. Williams Co., New London	**31.00**	----
12601	Royal Bone Phosphate	Williams & Clark Fertilizer Co., N. Y.	R. B. Witter, Brooklyn	**25.00**	14.84
12210	Standard Fertilizer	Standard Fertilizer Co., Boston	H. F. Child, Woodstock	**28.00**	16.62
12507	Bowker's Sure Crop Phosphate	Bowker Fertilizer Co., Boston	H. E. Kelsey, Westbrook	**25.00**	14.73
12661	Bay State G. G.	Clark's Cove Fertilizer Co., Boston	E. Bishop, New London	**28.00**	16.48
12583	Original Bay State Bone Superphosphate	H. F. Tucker Co., Boston	J. F. Lester, Norwich	26.00	16.39
			Nathan Lanz, Rockville	30.00	----
				28.00	----
12431	A. A. Ammoniated Superphosphate	East India Chemical Works, H. J. Baker & Bros., Prop., New York	F. S. Platt, New Haven	40.00	20.41
			Saxton & Strong, Bristol	31.50	----
				35.00	----

Analyses and Valuations—*Continued.*

Station No.	Percentage difference between cost and valuation.	Nitrogen					Phosphoric Acid.							Potash.		
		Nitrogen as Nitrates.	Nitrogen as Ammonia.	Nitrogen, Organic.	Total Nitrogen. Found.	Total Nitrogen. Guaranteed.	Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Found. As Muriate.	Found. Total.	Guaranteed.
12411	59.5	.46	.30	2.16	2.92	*2.5*	3.12	8.14	1.84	13.10	*12.0*	11.26	*10.0*	2.97	2.97	*2.5*
12492	59.8	.26	----	1.32	1.58	*0.8*	4.59	4.14	1.25	9.98	*9.0*	8.73	*8.0*	3.21	3.21	*2.0*
12463	61.0	----	----	1.14	1.14	*0.8*	6.69	2.11	1.10	9.90	----	8.80	*8.0*	4.93	4.93	*5.0*
12346	61.6	.35	.12	2.25	2.72	*2.5*	6.02	3.33	2.45	11.80	*11.0*	9.35	*7.0*	2.30	2.30	*2.0*
12667	62.3	.10	----	2.21	2.31	*2.1*	7.26	2.83	1.40	11.49	*9.0*	10.09	*8.0*	3.17	3.17	*3.0*
12467	63.4	----	----	1.09	1.09	*0.8*	7.17	2.22	1.19	10.58	...	9.39	*8.0*	4.16	4.16	*4.0*
12543	64.9	----	----	1.20	1.20	*0.8*	5.36	2.61	1.61	9.58	*9.0*	7.97	*7.0*	1.43	1.43	*1.0*
12657	65.1	----	----	1.48	1.48	*1.2*	6.58	3.14	2.10	11.82	*11.5*	9.72	*9.5*	2.04	2.04	*2.0*
12448	65.9	.38	----	1.66	2.04	*1.7*	5.01	3.85	2.44	11.30	*10.0*	8.86	*8.0*	3.19	3.19	*3.0*
12508	66.5	.79	----	1.16	1.95	*1.5*	----	7.46	5.77	13.23	----	7.46	*6.0*	1.01	2.25	*2.0*
12385	67.5	.56	.12	2.08	2.76	*2.5*	6.80	2.99	1.49	11.28	*10.0*	9.79	*9.0*	1.92	2.11	*2.0*
12601	68.5	----	----	1.51	1.51	*1.0*	6.02	2.72	2.19	10.93	*8.0*	8.74	*7.0*	2.51	2.51	*2.0*
12210	68.5	.30	----	1.91	2.21	*2.0*	5.52	3.22	2.66	11.40	*10.0*	8.74	*8.0*	2.25	2.25	*2.0*
12507	69.7	.12	----	.93	1.05	*0.8*	6.10	4.08	1.73	11.91	*11.0*	10.18	*9.0*	2.81	2.81	*2.0*
12661	69.9	----	.16	1.89	2.05	*1.9*	5.67	4.08	1.94	11.69	*10.0*	9.75	*8.5*	1.85	1.85	*2.0*
12583	70.8	.26	----	1.86	2.12	*2.1*	5.09	3.99	2.18	11.26	*11.0*	9.08	*9.0*	2.22	2.22	*2.0*
12431	71.5	.52	1.00	1.44	2.96	*2.5*	8.08	2.62	.90	11.60	*11.0*	10.70	*10.0*	2.76	2.76	*2.0*

NITROGENOUS SUPERPHOSPHATES. SAMPLED BY THE STATION.

Station No.	Name of Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
12587	Dissolved Bone and Potash	Lowell Fertilizer Co., Boston	F. S. Bidwell, Windsor Locks	$28.00	$16.84
			J. F. Sheridan & Bro., Manchester	30.00	----
				29.00	----
12337	Bowker's Farm and Garden Phosphate	Bowker Fertilizer Co., Boston	Linsley & Lightbourn, New Haven	35.00	16.13
			H. B. Sherwood, Southport	**28.00**	----
			E. B. Clark Co., Milford	24.00	----
12477	Imperial Bone Superphosphate	H. F. Tucker Co., Boston	C. J. Goodale, Glastonbury	**28.00**	16.08
			L. A. Fenton, Norwich Town	28.00	----
12576	Superphosphate	Cleveland Dryer Co., Boston	C. M. Holbrook, Willimantic	**30.00**	17.17
12600	Cereal Brand	Fred'k Ludlam, New York	J. M. Beckwith, Chesterfield	**23.00**	13.16
12516	Niagara Phosphate	Bradley Fertilizer Co., Boston	P. Schwartz, Chesterfield	**22.00**	12.54
12350	Cereal Brand	Mapes F. & P. G. Co., New York	Birdsey & Foster, Meriden	**27.00**	15.31
			A. N. Clark, Milford	28.00	----
12482	B. D. Sea Fowl Guano	Bradley Fertilizer Co., Boston	W. W. Cooper, Suffield	**30.00**	16.92
			F. S. Bidwell, Windsor Locks	30.00	----
12573	High Grade Ammoniated Bone Superphosphate	E. Frank Coe Co., New York	J. R. Babcock, Mystic	----	17.39
				31.00	----
12501	Special Phosphate	Olds & Whipple, Hartford	Manufacturer	**34.00**	18.96
12389	Superphosphate	Cumberland Bone-Phosphate Co., Boston	Kahn Bros., Yantic	27.00	15.88
			Thos. McLyman, Greenville	30.00	----
				28.50	----
12588	Bone Fertilizer	Lowell Fertilizer Co., Boston	H. A. Bugbee, Willimantic	**28.00**	15.58
			C. W. Lines, New Britain	28.00	----
			A. A. Snow, Clinton	28.00	----
12650	Soluble Pacific Guano	Pacific Guano Co., Boston	Saxton & Strong, Bristol	**33.00**	18.35
12642	Fish, Bone and Potash	Read Fertilizer Co., New York	W. J. Warner, Gilead	**29.00**	15.97
12343	Ammoniated Bone Phosphate	Berkshire Mills Co., Bridgeport	J. W. Palmer, Stamford	**28.00**	15.41
			Manufacturer	----	----
12211	Standard Guano for all Crops	Standard Fertilizer Co., Boston	H. F. Child, Woodstock	**25.00**	13.66
12643	Leader Guano	Read Fertilizer Co., New York	Lewis Ford, Norwich	**25.00**	13.60

ANALYSES AND VALUATIONS—*Continued.*

Station No.	Percentage difference between cost and valuation.	NITROGEN.					PHOSPHORIC ACID.							POTASH.		
		Nitrogen as Nitrates.	Nitrogen as Ammonia.	Nitrogen, Organic.	Total Nitrogen.		Soluble.	Reverted.	Insoluble.	Total.		Available.		Found.		Guaranteed.
					Found.	Guaranteed.				Found.	Guaranteed.	Found.	Guaranteed.	As Muriate.	Total.	
12587	72.2	....	....	2.16	2.16	*1.7*	3.23	6.69	1.15	11.07	*10.0*	9.92	*9.0*	2.43	2.43	*2.0*
12337	73.6	.29	....	1.59	1.88	*1.6*	6.67	3.02	1.62	11.31	*11.0*	9.69	*9.0*	2.21	2.21	*2.0*
12477	74.1	.79	....	1.16	1.95	*1.3*	6.30	3.01	1.74	11.05	*11.0*	9.31	*9.0*	2.44	2.44	*1.9*
12576	74.7	....	....	2.20	2.20	*2.1*	6.74	3.15	1.94	11.83	....	9.89	*9.0*	1.93	1.93	*2.0*
12600	74.8	.20	....	.76	.96	*0.8*	6.16	3.96	2.07	12.19	*10.0*	10.12	*8.0*	1.16	1.16	*1.0*
12516	75.4	....	....	1.20	1.20	*0.8*	5.73	2.68	1.82	10.23	*8.0*	8.41	*7.0*	1.35	1.35	*1.1*
12350	76.4	....	....	2.00	2.00	*1.7*	1.92	5.75	1.66	9.33	*8.0*	7.67	*6.0*	3.20	3.20	*3.0*
12482	77.3	....	....	2.18	2.18	*2.1*	6.48	3.67	1.93	12.08	*10.0*	10.15	*8.0*	1.51	1.51	*1.5*
12573	78.3	....	.20	1.80	2.00	*1.9*	7.55	2.24	1.38	11.17	*11.0*	9.79	*9.0*	.30	2.65	*2.3*
12501	79.3	.73	....	2.12	2.85	*2.5*	6.21	4.06	1.18	11.45	*10.0*	10.27	*9.0*	.40	1.94	*2.0*
12389	79.5	.24	....	1.74	1.98	*2.1*	4.86	4.12	2.41	11.39	*10.0*	8.98	*8.0*	2.09	2.09	*2.0*
12588	79.7	....	....	1.85	1.85	*1.7*	4.29	4.07	1.11	9.47	*9.0*	8.36	*8.0*	3.34	3.34	*3.0*
12650	79.8	....	....	2.60	2.60	*2.3*	4.92	5.59	1.79	12.30	*10.5*	10.51	*8.5*	1.71	1.71	*2.0*
12642	81.6	....	....	2.59	2.59	*2.5*	3.48	1.86	1.55	6.89	....	5.34	*4.0*	4.09	4.09	*4.0*
12343	81.7	....	....	1.15	1.15	*0.8*	6.29	3.42	3.22	12.93	*10.0*	9.71	*8.0*	.35	2.55	*2.0*
12211	83.0	....	....	1.30	1.30	*1.0*	6.22	2.29	2.03	10.54	*10.0*	8.51	*8.0*	2.09	2.09	*2.0*
12643	83.8	....	....	1.21	1.21	*0.8*	5.25	3.57	1.66	10.48	*8.0*	8.82	*7.0*	2.31	2.31	*2.0*

NITROGENOUS SUPERPHOSPHATES. SAMPLED BY THE STATION.

Station No.	Name of Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
12640	Guano for all Crops	Standard Fertilizer Co., Boston	F. J. Newton, Branford	$26.00	$14.11
12402	Standard Superphosphate	Read Fertilizer Co., New York	Lewis Ford, Norwich	28.00	15.00
			F. L. Dimmock, New London	28.00	----
12602	Fish and Potash	Williams & Clark Fertilizer Co., New York	T. B. Atwater, Plantsville	32.00	16.79
12468	Climax Phosphate	Quinnipiac Co., Boston	J. P. Lathrop, Plainfield	28.00	14.52
			S. V. Osborn, Branford	28.00	----
12580	Fertilizer for all Crops	Cleveland Dryer Co., Boston	J. T. Peckham, Norwich	28.00	14.42
12668	Fish and Potash	W. E. Brightman, Tiverton, R. I.	Wm. Crane, Broad Brook	28.00	14.34
12654	Buffalo Fertilizer	Milsom Rend. & Fert. Co., E. Buffalo, N. Y.	J. R. Gilbert, Gilead	26.50	13.52
12639	Fertilizer	Standard Fertilizer Co., Boston	J. W. Howe & Son., So. Glastonbury	34.00	17.06
12636	Columbian Phosphate	Berkshire Mills Co., Bridgeport	J. W. Palmer, Stamford	26.00	12.24
			P. Schwartz, Chesterfield	21.00	----
			L. Mullaly, Windsor	28.00	----
				25.00	----
12498	Buffalo Guano	Milsom Rend. & Fert. Co., E. Buffalo, N. Y.	C. H. Davis, Guilford	25.00	13.44
			A. L. Anderson & Son, Tolland	30.00	----
				27.50	----
12660	King Philip Alkaline Guano	Clark's Cove Fertilizer Co., Boston	J. M. Burke, So. Manchester	28.00	12.75
12648	Nobsque Guano for all Crops	Pacific Guano Co., Boston	J. O. Fox & Co., Putnam	32.00	14.04
12577‡	Erie King	Milsom Rend. & Fert. Co., E. Buffalo, N. Y.	L. B. James, Scotland	25.00	10.19

‡ See page 47.

2 and 3. Nitrogenous Superphosphates. Sampled by Manufacturers and Purchasers.

12809. Fish and Potash. Anchor Brand, made by the Bradley Fertilizer Co., Boston. Sample deposited with the Director of the Station by the manufacturer.

12326. Conn. Valley Orchard Co.'s Fertilizer, made for the Conn. Valley Orchard Co., Berlin. Sampled by Earl Cooley, Berlin.

12584 and **12586.** Special Mixtures. Sampled and sent by A. E. Plant, Branford.

ANALYSES AND VALUATIONS—*Continued.*

Station No.	Percentage difference between cost and valuation.	NITROGEN.					PHOSPHORIC ACID.							POTASH.		
		Nitrogen as Nitrates.	Nitrogen as Ammonia.	Nitrogen, Organic.	Total Nitrogen.		Soluble.	Reverted.	Insoluble.	Total.		Available.		Found.		Guaranteed.
					Found.	Guaranteed.				Found.	Guaranteed.	Found.	Guaranteed.	As Muriate.	Total.	
12640	84.3	----	----	1.43	1.43	*1.0*	5.72	2.68	2.07	10.47	*10.0*	8.40	*8.0*	2.34	2.34	*2.0*
12402	86.7	----	----	1.06	1.06	*0.8*	6.90	2.24	1.24	10.38	*9.0*	9.14	*8.0*	4.15	4.15	*4.0*
12602	90.6	.14	0.30	1.87	2.31	*2.1*	2.78	3.61	1.90	8.29	*6.0*	6.39	*4.0*	4.88	4.88	*4.0*
12468	92.8	----	----	1.44	1.44	*1.0*	6.43	2.33	1.90	10.66	*9.0*	8.76	*8.0*	2.45	2.45	*2.0*
12580	94.2	.11	----	1.40	1.51	*1.0*	4.59	4.21	2.46	11.26	*8.0*	8.80	*7.0*	2.05	2.05	*2.0*
12668	95.3	----	0.40	1.64	2.04	*2.1*	1.84	4.36	3.07	9.27	*7.5*	6.20	*6.0*	2.55	2.55	*2.0*
12654	96.0	----	----	1.93	1.93	*1.9*	4.59	2.81	1.60	9.00	*9.0*	7.40	*8.0*	1.29	1.29	*1.5*
12639	99.3	----	0.15	2.09	2.24	*2.0*	5.06	4.78	1.68	11.52	*10.0*	9.84	*8.0*	2.02	2.02	*2.0*
12636	104.2	----	----	----	----	----	2.55	7.85	3.21	13.61	*12.0*	10.40	*10.0*	.23	2.41	*2.0*
12498	104.6	----	----	.90	.90	*0.8*	6.15	2.22	1.01	9.38	*9.0*	8.37	*8.0*	3.76	3.76	*4.0*
12660	119.6	----	----	1.07	1.07	*1.1*	6.16	2.03	1.86	10.05	*9.0*	8.19	*8.0*	2.18	2.18	*2.0*
12648	127.9	----	----	1.33	1.33	*1.2*	6.22	2.46	2.02	10.70	*9.0*	8.68	*8.0*	2.28	2.28	*2.0*
12577‡	145.3	----	----	.96	.96	*0.8*	4.02	2.19	1.31	7.52	*9.0*	6.21	*7.0*	1.89	1.89	*2.0*

‡ See page 47.

ANALYSES AND VALUATIONS.

	12809	12326	12584	12586
Nitrogen as nitrate.....	....	1.72	....	....
" ammonia	....	....	0.47	0.76
" organic	3.58	2.60	3.21	3.08
Nitrogen, total	3.58	4.32	3.68	3.84
Soluble phosphoric acid	3.92	5.70	0.61	3.07
Reverted phosphoric acid...	2.48	3.57	9.19	2.82
Insoluble phosphoric acid...	1.60	1.73	1.75	0.51
Total phosphoric acid.....	8.00	11.00	11.55	6.40
Potash as muriate	3.37	3.09	8.70	10.18
Potash as sulphate	....	....	....	....
Potash, total	3.37	3.09	8.70	10.18
Cost per ton.....	$28.00	$25.00	....	....
Valuation per ton.....	19.03	22.89	26.40	24.77

SPECIAL MANURES.

Here are included such mixed fertilizers, chiefly nitrogenous superphosphates, as are claimed by their manufacturers to be specially adapted to the needs of particular crops.

1. *Samples Drawn by Station Agent.*

In the table on pages 64 to 79 are given analyses of one hundred and eight samples drawn by the Station agents and representing one hundred and five brands.

GUARANTEES.

Of the one hundred and eight samples analyzed, twenty-one do not fulfill the manufacturer's minimum guarantee in respect of one ingredient, and nine are each deficient in respect of two ingredients.

Six were deficient in nitrogen, twenty-four in potash, and nine in phosphoric acid.

COST AND VALUATION.

The average cost per ton of the one hundred and eight samples examined was $32.64, the valuation $21.76 and the percentage difference 50.0.

In 1898 the corresponding figures were: Average cost, $33.11; average valuation, $21.72, percentage difference 52.4.

Analyses Requiring Special Notice.

The Rogers Mfg. Co.'s High Grade Grass and Grain Manure, **12627**, Mapes' Seeding Down Manure, **12476**, Hubbard's Grass and Grain Manure, **12811** and **12456**, and Hubbard's Oat and Top Dressing Manure, **12455**, analyses of which appear on pages 65, 67 and 69 of the table, are mixtures of bone with chemicals.

The mechanical analyses of the bone in these fertilizers, are as follows:

	12627	12476	12811	12456	12455
Per cent. fine, smaller than $^1/_{50}$ inch.....	81	85	53	50	54
Per cent. coarse, larger than $^1/_{50}$ inch....	19	15	47	50	46
	100	100	100	100	100

The manufacturers objected that the analyses of Hubbard's Grass and Grain Manure, **12456**, given on page 68, did not fairly represent their goods, as it showed more nitrogen and

considerably less phosphoric acid and potash than this brand was made to contain. At the request of the Rogers & Hubbard Co., another sample was drawn, **12811**, and analyzed with the results given on page 67. This last analysis conforms to the manufacturer's guarantee.

The Milsom Rendering Co. objected that the analysis of their Potato, Hop and Tobacco Phosphate, **12483**, page 79, was very low in potash and in available phosphoric acid.

They asked that other samples be drawn and analyzed, but the sampling agent was not able to find it on sale any more.

The Quinnipiac Co. requested another analysis of their Potato Manure, because the one first reported, **12353**, showed a deficiency of potash. Accordingly another sample was drawn, **12812**, the analysis of which appears on page 69 of the table, and shows a very different composition as well as different ingredients, the one containing a considerable quantity of nitrate, while the other contains none.

The sample of Brightman's Tobacco Special and Market Garden Fertilizer, **12666**, was stated to have been drawn from stock left over in the dealer's warehouse from the season of 1898. A second sample of the same brand, from goods made in the fall of 1899, was therefore drawn, **14029** and analyzed with the results given on page 67.

Neither of these analyses, however, represent the goods sold in Connecticut in the spring of 1899, which were guaranteed to be free from chlorine. The manufacturers stated that **14029** was made in the fall of 1899, and that the potash used was from a lot bought for and billed to them as high grade sulphate. After receiving the analysis, investigation showed that the 50 ton lot sold to them as sulphate was largely muriate.

The Cleveland Dryer Co. requested another analysis of their Potato Phosphate, **12665**, page 69, because of a deficiency of nitrogen and potash as shown by the analysis of this sample.

It was impossible to find the goods on sale in the State after the request was made.

Special Manures Sampled by the Station.

Station No.	Name of Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
12627*	High Grade Grass and Grain	Rogers Mfg. Co., Rockfall	Manufacturer	$37.00	$33.59
12466	Complete for Potatoes, Roots and Vegetables	Russia Cement Co., Gloucester, Mass.	E. N. Pierce, Plainville	34.00	30.42
			C. A. Young & Co., Danielson	35.00	----
12493	Special Tobacco Manure	Russia Cement Co., Gloucester, Mass.	G. W. Pomeroy, East Granby	43.00	34.85
			H. C. Aborn & Son., Ellington	42.00	----
12539	Tobacco Grower	L. B. Darling Fertilizer Co., Pawtucket, R. I.	Loomis Bros., Granby	38.00	31.24
12598	Hess' Tobacco Manure	S. M. Hess & Bro., Philadelphia, Pa.	Joseph Amstead, Windsor Locks	33.00	26.09
12476*	Seeding Down Manure	Mapes F. & P. G. Co., New York	Mapes Branch, Hartford	37.00	29.17
12514	Bowker's Tobacco Ash Elements	Bowker Fertilizer Co., Boston	Bowker's Branch	30.00	23.29
12595	Potato, Onion and Tobacco Manure	Wilcox Fertilizer Works, Mystic	I. W. Dennison, Mystic	35.00	26.49
			C. M. Smith, E. Hartford	36.00	----
12352	Economical Potato Manure	Mapes F. & P. G. Co., New York	Geo. S. Jennings, Southport	30.00	23.28
			Henry F. Quintard, Sound Beach	31.00	----
			Mapes Branch, Hartford	33.00	----
12480	Tobacco Manure Wrapper Brand	Mapes F. & P. G. Co., New York	C. K. & H. T. Hale, Gildersleeve	44.00	33.02
			W. W. Cooper, Suffield	46.00	----
12335	Hubbard's Soluble Tobacco Manure	Rogers & Hubbard Co., Middletown	H. W. Andrews, Wallingford	42.00	31.50
			A. E. Kilbourn, East Hartford	42.00	----
12378	Potato Phosphate	Lowell Fertilizer Co., Boston	G. C. Ingham, Saybrook	30.00	22.45
			A. A. Snow, Clinton	33.00	----
12637	Mystic Gilt Edge Potato Manure	C. M. Shay, Groton	Manufacturer	30.00	22.36
12334	Hubbard's Soluble Potato Manure	Rogers & Hubbard Co., Middletown	H. W. Andrews, Wallingford	38.00	28.23
			A. E. Kilbourn, East Hartford	38.00	----
12471	Tobacco Ash Constituents	Mapes F. & P. G. Co., New York	C. K. & H. T. Hale, Gildersleeve	32.00	22.29
			Mapes Branch, Hartford	30.00	----
12591	High Grade Soluble Tobacco Manure	Rogers Mfg. Co., Rockfall	Manufacturer	42.00	31.19
			N. H. Root, New Milford	42.00	----

* See page 62.

Analyses and Valuations.

Station No.	Percentage difference between cost and valuation.	Nitrogen					Phosphoric Acid.							Potash.		
		Nitrogen as Nitrates.	Nitrogen as Ammonia.	Nitrogen Organic.	Total Nitrogen.		Soluble.	Reverted.	Insoluble.	Total.		Available.		Found.		Guaranteed.
					Found.	Guaranteed.				Found.	Guaranteed.	Found.	Guaranteed.	As Muriate.	Total.	
12627*	10.2	----	----	2.79	2.79	*2.5*	----	----	----	19.61	*16.5*	----	----	14.12	14.12	*12.5*
12466	11.7	----	.70	3.34	4.04	*3.7*	5.68	5.60	1.25	12.53	*9.0*	11.28	----	.29	8.92	*8.5*
12493	20.5	----	1.24	3.46	4.70	*4.5*	5.34	4.20	.54	10,08	*8.0*	9.54	----	.33	13.10	*12.0*
12539	21.6	----	2.66	2.78	5.44	*4.9*	4.70	1.81	.22	6.73	*8.0*	6.51	*7.0*	1.08	9.87	*10.0*
12598	26.5	----	.56	3 45	4.01	*3.3*	5.54	2.26	1.56	9.36	----	7.80	*8.0*	1.39	7.54	*7.0*
12476*	26.8	1.40	----	1.08	2.48	*2.5*	----	----	----	18.55	*18.0*	----	----	10.65	10.65	*10.0*
12514	28.8	----	----	----	----	----	.13	7.76	3.16	11.05	----	7.89	*6.0*	1.32	15.90	*15.0*
12595	32.1	.95	.55	2.55	4.05	*3.3*	4.70	4.52	1.18	10 40	*8.0*	9.22	*7.0*	.25	7.04	*6.0*
12352	33.2	1.15	----	2.37	3.52	*3.3*	1.44	3.94	1.20	6.58	*6.0*	5.38	*4.0*	1.44	9.05	*8.0*
12480	33.3	3.50	1.28	1.72	6.50	*6.2*	.26	5.09	.53	5.88	*4.5*	5.35	----	2.23	11.43	*10.5*
12335	33.3	1.38	----	3.78	5.16	*5.0*	1.46	6.80	2.70	10.96	*10.0*	8.26	*7.0*	.60	9.73	*10.0*
12378	33.6	----	.29	2.63	2.92	*2.5*	6.96	1.72	1.00	9.68	*9.0*	8.68	*8.0*	.08	6.19	*6.0*
12637	34.2	.67	.30	2.04	3.01	*3.0*	5.18	5.06	1.92	12.16	*9.0*	10.24	*8.0*	5.40	5.40	*5.0*
12334	34.6	1.66	----	3.70	5.36	*5.0*	1.14	6.34	2.54	10 02	*10.0*	7.48	*7.0*	1.00	6.75	*5.0*
12471	34.6	----	----	.73	.73	*0.5*	----	5.09	1.20	6.29	*5.7*	6.29	----	3.25	16.19	*15.0*
12591	34.7	1.44	.32	3.17	4.93	*5.0*	2.30	5.88	1.86	10.04	*8.0*	8.18	----	.85	10.37	*11.0*

* See page 62.

Special Manures Sampled by the Station.

Station No.	Name of Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
12811†	Hubbard's Grass and Grain	Rogers & Hubbard Co., Middletown	Strong & Tanner, East Winsted	$38.00	$28.22
12606	Oats and Top Dressing	Rogers Mfg. Co., Rockfall	Manufacturer	42.00	30.99
			D. W. Spencer, Centerbrook	40.00	----
12655	Tobacco Manure	Lowell Fertilizer Co., Boston	Thos. Lee, Brookfield	40.00	29.35
12450	Grain Grower	Armour Fertilizer Works, Chicago	C. J. Benham, New Haven	23.00	17.49
			E. A. Buck & Co., Willimantic	25.00	----
				24.00	----
12589	Fruit and Vine	Lowell Fertilizer Co., Boston	G. C. Ingham, Saybrook	32.00	23.89
			H. A. Bugbee, Willimantic	35.00	----
			Thos. Lee, Brookfield	34.00	----
				33.00	
12604	Complete Corn	Rogers Mfg. Co., Rockfall	N. H. Root, New Milford	35.00	25.21
			Manufacturer	35.00	
12541	Corn Manure	East India Chemical Works, H. J. Baker & Bro., Props., New York	Wm. Stevenson, South Glastonbury	35.00	25.16
12330	Potato Manure	Mapes F. & P. G. Co., New York	Mapes Branch, Hartford	36.00	25.69
			Birdsey & Foster, Meriden	37.00	----
			A. N. Clark, Milford	38.00	----
12455†	Hubbard's Oats and Top Dressing	Rogers & Hubbard Co., Middletown	H. W. Andrews, Wallingford	49.00	34.94
			W. O. Goodsell, Bristol	49.00	----
			Manufacturer	----	----
12409	Complete for Potatoes & Vegetables	Bradley Fertilizer Co., Boston	C. O. Jelliff & Co., Southport	32.00	23.51
			J. M. Todd, Forestville	35.00	----
				33.00	
14029‡	Tobacco Special and Market Garden Manure	W. E. Brightman, Tiverton, R. I.	William Crane, Broad Brook	35.00	24.88
12515	Bowker's Tobacco Ash Fertilizer	Bowker Fertilizer Co., Boston	Bowker's Branch Hartford	40.00	28.41
12473	Potato Manure	L. Sanderson, New Haven	A. B. Morse, Guilford	30.00	21.24
			Manufacturer	30.00	----
12453	Potato and Root Crop Manure	L. B. Darling Fertilizer Co., Pawtucket, R. I.	A. I. Kinne, Terryville	34.00	24.04
			Hotchkiss & Templeton, Waterbury	35.00	----
			J. S. Warner, Glastonbury	35.00	----
12518	Complete Tobacco Manure	East India Chemical Works, H. J. Baker Bro., Props., New York	Wm. Stevenson, South Glastonbury	42.00	29.62

† See page 62. ‡ See page 63.

Analyses and Valuations—*Continued.*

Station No.	Percentage difference between cost and valuation.	Nitrogen					Phosphoric Acid.							Potash.		
		Nitrogen as Nitrates.	Nitrogen as Ammonia.	Nitrogen Organic.	Total Nitrogen. Found.	Total Nitrogen. Guaranteed.	Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Found. As Muriate.	Found. Total.	Guaranteed.
12811†	34.7	trace	.39	2.18	2.57	*2.5*	----	----	----	17.47	*16.5*	----	----	13.03	13.03	*12.5*
12606	35.5	4.88	----	1.77	6.65	*6.3*	1.76	5.73	1.53	9.02	*9.0*	7.49	----	8.30	8.30	*7.5*
12655	36.3	1.74	.38	3.12	5.24	*4.9*	4.92	1.56	.26	6.74	*7.0*	6.48	*6.0*	.45	9.41	*8.0*
12450	37.2	----	----	1.92	1.92	*1.7*	3.50	6.43	2.67	12.60	*10.0*	9.93	----	.37	2.80	*2.0*
12589	38.1	----	.30	3.48	3.78	*3.3*	5.76	2.39	.73	8.88	*9.0*	8.15	*8.0*	.85	6.00	*6.0*
12604	38.8	1.24	----	2.49	3.73	*3.6*	4.78	5.19	1.66	11.63	*8.0*	9.97	----	7.09	7.09	*7.0*
12541	39.1	.70	1.47	2.08	4.25	*4.0*	5.30	1.81	.58	7.69	*7.0*	7.11	*6.0*	7.92	7.92	*7.0*
12330	40.1	1.78	1.52	.54	3.84	*3.6*	3.04	5.52	1.48	10.04	*8.0*	8.56	*8.0*	1.41	7.63	*6.0*
12455†	40.2	7.49	----	1.32	8.81	*8.8*	----	----	----	8.46	*7.9*	----	----	9.17	9.17	*8.4*
12409	40.4	.73	----	2.60	3.33	*3.3*	4.91	3.93	1.83	10.67	*9.0*	8.84	*8.0*	7.19	7.19	*6.0*
14029‡	40.7	1.68	----	1.84	3.52	*3.3*	4.48	4.68	1.84	11.00	*9.0*	9.16	*8.0*	3.28	7.51	*7.0*
12515	40.8	3.12	----	.11	3.23	*3.0*	.18	6.98	5.06	12.22	----	7.16	*5.0*	.39	12.60	*13.0*
12473	41.2	.23	----	2.92	3.15	*1.6*	3.33	4.53	2.20	10.06	*9.0*	7.86	*5.0*	5.86	5.86	*6.0*
12453	41.4	.52	.20	2.28	3.00	*2.9*	7.23	2.93	.35	10.51	*10.0*	10.16	*7,0*	7.96	7.96	*7.0*
12518	41.8	.43	2.91	1.32	4.66	*4.5*	4.13	1.37	.93	6.43	----	5.50	*4.0*	.73	11.03	*10.0*

† See page 62. ‡ See page 63.

Special Manures Sampled by the Station.

Station No.	Name of Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
12817	New England Potato and Tobacco Grower	Crocker Fertilizer and Chemical Co., Buffalo, N. Y.	C. F. Tallard & Son, Broad Brook	$30.00	$20.89
			Latimer & Williams, So. Coventry	31.00	----
			William Orr, Southington	30.00	----
12392	New England Potato and Tobacco Grower	Crocker Fertilizer and Chemical Co., Buffalo, N. Y.	S. E. Dowd, Clinton	32.00	20.84
			Haley & Chesebro, Stonington	38.00	----
				30.00	
12428	Complete for Corn, Grain and Grass	Russia Cement Co., Gloucester, Mass.	E. N. Pierce, Plainville	40.00	27.75
			J. M. White, Bristol	43.00	----
12456†	Hubbard's Grass and Grain	Rogers & Hubbard Co., Middletown	Manufacturer	38.00	26.13
			John Bransfield, Portland	37.00	----
12347	Bowker's Early Potato Manure	Bowker's Fertilizer Co., Boston	J. F. Buckhout, Greenwich	35.00	23.36
			Bowker's Branch, Hartford	35.00	----
			H. B. Sherwood, Southport	33.00	----
			E. B. Clark Co., Milford	32.00	----
				34.00	
12812†	Potato Manure	Quinnipiac Co., Boston	G. W. Williams Co., New London	31.00	21.28
12512	Stockbridge Top Dressing	Bowker Fertilizer Co., Boston	W. B. Martin, Rockville	37.00	25.29
12433	Complete for Corn and Grain	Bradley Fertilizer Co., Boston	Conn. School for Boys, Meriden	----	22.52
			S. J. Stevens, Glastonbury	33.00	----
12429	Potato Fertilizer	Russia Cement Co., Gloucester, Mass.	A. R. Manning & Co., Yantic	32.00	21.83
			J. M. White, Bristol	43.00	----
12449	Hubbard's Potato Phosphate	Rogers & Hubbard Co., Middletown	Manufacturer	30.00	20.36
			G. W. Dennison, Saybrook	30.00	----
12395	Fruit Fertilizer	M. E. Wheeler & Co., Rutland, Vt.	G. C. Ingham, Saybrook	24.00	17.64
			D. G. Chesebro, Center Groton	28.00	----
			Dwight Gallup, Old Mystic	26.00	----
12479	Essex Tobacco Starter	Russia Cement Co., Gloucester, Mass.	W. W. Cooper, Suffield	34.00	22.00
			J. B. Parker, Jr., Poquonock	31.00	----
				32.50	
12665†	Potato Phosphate	Cleveland Dryer Co., Boston	A. H. Bates, Windham	26.00	17.57

† See page 63.

Analyses and Valuations—*Continued.*

Station No.	Percentage difference between cost and valuation.	Nitrogen					Phosphoric Acid.							Potash.		
		Nitrogen as Nitrates.	Nitrogen as Ammonia.	Nitrogen Organic.	Total Nitrogen. Found.	Total Nitrogen. Guaranteed.	Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Found. As Muriate.	Found. Total.	Guaranteed.
12817	43.6	----	----	3.16	3.16	*3.3*	3.18	4.26	1.93	9.37	----	7.44	*6.0*	2.40	5.36	*5.4*
12392	44.0	----	----	3.35	3.35	*3.3*	3.41	3.86	1.66	8.93	----	7.27	*6.0*	1.87	4.92	*5.4*
12428	44.1	1.00	.38	2.60	3.98	*3.7*	4.13	5.21	1.65	10.99	*9.5*	9.34	----	9.74	9.74	*9.5*
12456†	45.4	----	----	3.10	3.10	*2.5*	----	----	----	16.08	*16.5*	----	----	10.63	10.63	*12.5*
12347	45.5	1.10	----	2.32	3.42	*3.0*	5.95	2.79	1.23	9.97	*9.0*	8.74	*7.0*	7.09	7.09	*7.0*
12812†	45.7	----	----	3.13	3.13	*2.5*	3.26	3.19	3.77	10.22	*7.0*	6.45	*6.0*	6.50	6.50	*5.0*
12512	46.3	2.60	----	2.22	4.82	*4.8*	6.51	1.78	.32	8.61	*6.0*	8.29	*4.0*	6.07	6.07	*6.0*
12433	46.5	.30	.42	2.15	2.87	*3.3*	4.18	7.28	1.41	12.87	*13.0*	11.46	*12.0*	5.12	5.12	*3.0*
12429	46.6	.52	----	1.83	2.35	*2.0*	4.88	6.61	2.79	14.28	*11.0*	11.49	----	5.42	5.42	*5.0*
12449	47.3	.70	----	1.21	1.91	*2.0*	8.99	3.16	.60	12.75	*10.0*	12.15	*9.0*	5.13	5.13	*5.0*
12395	47.4	----	----	----	----	----	5.84	5.43	2.00	13.27	----	11.27	*10.0*	8.33	8.49	*8.0*
12479	47.7	1.46	----	1.54	3.00	*2.5*	4.91	6.88	2.31	14.10	*12.0*	11.79	----	.05	3.21	*2.5*
12665†	48.0	----	----	1.97	1.97	*2.1*	6.44	3.72	2.23	12.39	----	10.16	*8.0*	2.80	2.80	*3.0*

† See page 63.

Special Manures Sampled by the Station.

Station No.	Name of Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
12331	Fruit and Vine Manure	Mapes F. & P. G. Co., New York	Birdsey & Foster, Meriden	$38.00	$24.96
			Mapes Branch, Hartford	37.00	----
12666†	Tobacco Special & Market Garden	W. E. Brightman, Tiverton, R. I.	William Crane, Broad Brook	35.00	23.58
12432	Complete Potato Manure	East India Chemical Works, H. J. Baker & Co., Props., New York	Saxton & Strong, Bristol	39.00	26.28
			John Hartz, Burnside	40.00	----
12652	Conn. Wrapper Brand	Milsom Rend. & Fertz. Co., E. Buffalo, N. Y.	G. W. Barnes, Poquonock	35.00	23.52
12336	Stockbridge Potato and Vegetable	Bowker Featilizer Co., Boston	E. B. Clark Co., Milford	34.00	24.80
			Bowker's Branch, Hartford	36.00	----
				37.00	
12638	Groton Corn and Grain	C. M. Shay, Groton	Manufacturer	25.00	16.72
12658	Potato Manure	Lister's Agric. Chem. Works, Newark, N. J.	A. N. Clark, Milford	34.00	22.68
12332	Grass and Grain Spring Top Dressing	Mapes F. & P. G. Co., New York	Birdsey & Foster, Meriden	39.00	25.34
			Mapes Branch, Hartford	38.00	----
12485	Tobacco Fertilizer	Bradley Fertilizer Co., Boston	S. J. Stevens, Glastonbury	32.00	22.58
			W. W. Cooper, Suffield	38.00	----
				34.00	
12605	Complete Potato & Vegetable	Rogers Mfg. Co., Rockfall	F. S. Bidwell, Windsor Locks	32.00	21.13
			Manufacturer	32.00	----
			R. H. Hall, East Hampton	31.00	----
12379	Vegetable and Vine	Read Fertilizer Co., New York	Adams & Canfield, Winnipauk	30.00	18.43
			Albert Bender, Glenville	28.00	----
12662	Special Potato Manure	Crocker Fertz. & Chem. Co., Buffalo, N. Y.	F. M. Loomis, North Granby	----	23.24
				35.50	
12534	Northern Corn Special	Great Eastern Fertilizer Co., Rutland, Vt.	S. A. Post, Westbrook	31.00	18.96
			Strong & Tanner, East Winsted	29.00	----
12596	Potato Manure	Wilcox Fertilizer Works, Mystic	Lewis Ford, Norwich	29.00	17.55
			Manufacturer	27.00	----
			J. W. Dennison, Mystic	25.00	----
12403	Tobacco Starter Improved	Mapes F. & P. G. Co., New York	Mapes Branch, Hartford	33.00	21.37
			Southington Lumber & Feed Co., Southington	33.00	----

† See page 63.

Analyses and Valuations—*Continued.*

Station No.	Percentage difference between cost and valuation.	Nitrogen					Phosphoric Acid.							Potash.		
		Nitrogen as Nitrates.	Nitrogen as Ammonia.	Nitrogen Organic.	Total Nitrogen. Found.	Total Nitrogen. Guaranteed.	Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Found. As Muriate.	Found. Total.	Guaranteed.
12331	48.2	.55	----	1.63	2.18	*1.7*	3.15	3.81	.93	7.89	7.0	6.96	*5.0*	1.94	13.05	*10.0*
12666†	48.4	.70	----	2.84	3.54	*3.3*	5.24	3.49	1.89	10.62	*9.0*	8.73	*8.0*	6.60	6.60	*7.0*
12432	48.4	.77	1.28	1.64	3.69	*3.0*	4.94	1.85	.58	7.37	*6.0*	6.79	*5.0*	7.22	10.84	*10.0*
12652	48.8	----	.18	4.03	4.21	*4.1*	5.11	2.42	2.22	9.75	*9.0*	7.53	*8.0*	5.02	5.02	*5.0*
12336	49.2	1.02	----	2.48	3.50	*3.2*	5.21	2.85	.83	8.89	*8.0*	8.06	*6.0*	9.42	9.42	*10.0*
12638	49.5	----	.12	2.57	2.69	*1.8*	3.61	3.15	.96	7.72	*9.0*	6.76	*8.0*	3.54	3.54	*2.5*
12658	49.9	----	.74	2.61	3.35	*3.7*	6.17	1.89	1.54	9.60	*8.5*	8.06	*7.5*	6 44	6.44	*7.0*
12332	50.0	1.66	.71	2.83	5.20	*4.9*	2.90	2.23	1.07	7.20	*6.0*	5.13	*5.0*	7.44	7.44	*7.0*
12485	50.6	.56	.36	2.43	3.35	*3.3*	6.86	2.08	.57	9.51	*10.0*	8.94	*8.0*	5.97	6.13	*4.0*
12605	51.4	.49	----	1.87	2.36	*2.3*	7.14	4.54	1.16	12.84	*10.0*	11.68	----	4.87	4.87	*5.0*
12379	51.9	----	----	1.82	1.82	*1.7*	5.48	1.72	.46	7.66	*7.0*	7.20	*6.0*	8.05	8.05	*8.0*
12662	52.8	----	----	4.00	4.00	*3.7*	6.03	2.86	.70	9.59	----	8.89	*8.0*	4.75	4.75	*5.4*
12534	53.0	.56	----	2.54	3.10	*3.0*	6.86	2.51	1.20	10.57	----	9.37	*8.0*	2.10	2.10	*2.0*
12596	53.8	.49	----	2.04	2.53	*2.0*	2.90	3.73	2.13	8.76	*7.0*	6.63	*6.0*	4.91	4.91	*4.5*
12403	54.4	1.51	.68	2.17	4.36	*4.1*	2.03	6.06	1.97	10.06	*8.0*	8.09	*6.0*	0.85	2.13	*1.0*

† See page 63.

Special Manures Sampled by the Station.

Station No.	Name of Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
12328	Corn Manure	Mapes F. & P. G. Co., New York	Birdsey & Foster, Meriden	$34.00	$20.57
			Mapes' Branch, Hartford	32.00	----
12815	Potato Phosphate	National Fertilizer Co., Bridgeport	Gault Bros., Westport	32.00	20.51
			Ansonia Flour & Feed Co., Ansonia	----	----
			G. & A. H. Williams, E. Hartford	33.00	----
12490	Special Potato Fertilizer	H. F. Tucker Co., Boston	C. J. Goodale, Glastonbury	30.00	19.15
			L. A. Fenton, Norwich Town	30.00	----
12436	Bowker's Tobacco Starter	Bowker Fertilizer Co., Boston	Bowker's Branch, Hartford	34.00	21.67
			City Coal & Wood Co., New Britain	35.00	----
12465	Potato Phosphate	Quinnipiac Co., Boston	J. P. Lathrop, Plainfield	28.00	17.82
			C. A. Young & Co., Danielson	28.00	----
12631	Americus Potato Manure	Williams & Clark Fertilizer Co., New York	J. P. Kingsley, Plainfield	28.00	17.82
12590	Special Potato Fertilizer	Lister's Agricultural Chem. Works, Newark, N. J.	J. E. Leonard & Son, Jewett City	26.00	16.45
			J. P. Little, Columbia	26.00	----
12427	Stockbridge Corn Manure	Bowker Fertilizer Co., Boston	W. O. Goodsell, Bristol	37.00	23.40
			City Coal & Wood Co., New Britain	38.00	----
12621	Grass and Oat Fertilizer	M. E. Wheeler & Co., Rutland, Vt.	E. F. Strong, Colchester	19.00	12.01
12647	Special Potato	Quinnipiac Co., Boston	C. Buckingham, Southport	24.00	15.08
12408	High Grade Potato Manure	Packer's Union Fertilizer Co., New York	O. S. Rogers, Essex	34.00	19.92
			Nelson Dayton, New London	32.00	----
			A. S. Bennett, Cheshire	32.00	----
12344	Vegetable, Vine and Tobacco	Great Eastern Fertilizer Co., Rutland, Vt.	J. W. Palmer, Stamford	35.00	19.84
			Silas Finch, Greenwich	29.00	----
				32.00	----
12405	Potato Manure	M. E. Wheeler & Co., Rutland, Vt.	Dwight Gallup, Old Mystic	39.00	18.29
			D. G. Chesebro, Center Groton	28.00	----
			J. F. Blakeslee, North Haven	31.00	----
				29.50	----
12533	Potato and Truck Manure	S. M. Hess & Bro., Philadelphia, Pa.	C. I. Phelan, West Suffield	33.00	20.36
			M. S. Treat, Woodmont	34.00	----

Analyses and Valuations—*Continued.*

Station No.	Percentage difference between cost and valuation.	Nitrogen					Phosphoric Acid.							Potash.		
		Nitrogen as Nitrates.	Nitrogen as Ammonia.	Nitrogen, Organic.	Total Nitrogen.		Soluble.	Reverted.	Insoluble.	Total.		Available.		Found.		Guaranteed.
					Found.	Guaranteed.				Found.	Guaranteed.	Found.	Guaranteed.	As Muriate.	Total.	
12328	55.6	.77	.18	1.56	2.51	*2.5*	3.63	5.60	1.58	10.81	*10.0*	9.23	*8.0*	6.29	6.29	*6.0*
12815	56.0	----	.50	1.77	2.27	*2.0*	4.11	2.42	1.91	8.44	*8.0*	6.53	*6.0*	9.00	9.00	*8.0*
12490	56.7	.61	----	1.65	2.26	*2.0*	4.53	2.85	2.14	9.52	*9.0*	7.38	*8.0*	6.80	6.80	*6.0*
12436	56.9	.38	----	2.30	2.68	*2.3*	7.63	3.91	1.16	12.70	*12.0*	11.54	*8.0*	.92	3.96	*3.0*
12465	57.1	.21	----	2.06	2.27	*2.1*	4.90	3.93	3.16	11.99	*9.0*	8.83	*8.0*	3.19	3.19	*3.0*
12631	57.1	.29	----	1.88	2.17	*2.1*	5.93	2.97	2.51	11.41	*9.0*	8.90	*8.0*	.40	3.17	*3.0*
12590	58.1	----	----	1.86	1.86	*1.7*	6.08	3.16	1.84	11.08	*9.0*	9.24	*8.0*	2.94	2.94	*3.0*
12427	58.1	.68	----	2.64	3.32	*3.0*	7.39	2.06	.49	9.94	*10.0*	9.45	----	6.84	6.84	*6.0*
12621	58.2	----	----	----	----	----	6.99	4.00	1.45	12.44	----	10.99	*11.0*	2.28	2.28	*2.0*
12647	59.2	----	----	1.43	1.43	*1.2*	4.19	2.81	1.53	8.53	*7.0*	7.00	*6.0*	5.24	5.24	*5.0*
12408	60.6	----	----	2.23	2.23	*2.1*	7.39	1.80	.55	9.74	----	9.19	*8.0*	6.32	6.32	*6.0*
12344	61.3	----	----	2.27	2.27	*2.1*	7.20	2.04	.75	9.99	----	9.24	*8.0*	5.97	5.97	*6.0*
12405	61.3	----	----	2.41	2.41	*2.1*	6.50	2.94	1.05	10.49	----	9.44	*8.0*	3.43	3.43	*3.3*
12533	62.1	----	.55	2.10	2.65	*2.5*	4.26	4.41	1.13	9.80	----	8.67	*8.0*	5.90	5.90	*6.0*

Special Manures Sampled by the Station.

Station No.	Name of Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
12377	Potato Phosphate	Williams & Clark Fertilizer Co., New York	Geo. Beaumont, Wallingford	$32.00	$18.31
			J. G. Schwink, Meriden	**30.00**	----
12393	Potato Fertilizer	Bradley Fertilizer Co., Boston	P. Schwartz, Chesterfield	32.00	17.65
			D. L. Clark, Milford	**29.00**	
12388	Potato Fertilizer	Cumberland Bone-Phosphate Co., Boston	Kahn Bros., Yantic	27.00	17.63
			Thos. McLyman, Greenville	30.00	----
			D. C. Spencer, Saybrook	30.00	----
				29.00	----
12394	Corn Phosphate	Williams & Clark Fertilizer Co., New York	F. L. Dimmock, New London	29.00	17.02
			C. F. Boswell, Preston	**28.00**	----
12401	Corn Fertilizer	Russia Cement Co., Gloucester, Mass.	E. N. Pierce, Plainville	34.00	20.02
			A. R. Manning & Co., Yantic	32.00	----
			Irving Lockwood & Co., New Canaan	35.00	----
				33.00	----
12430	Celebrated Special Potato Fertilizer	E. Frank Coe Co., New York	J. R. Babcock, Mystic	**30.00**	17.94
			P. J. Bolan, Waterbury	35.00	----
12499	Potato Fertilizer	Clark's Cove Fertilizer Co., New York	E. Bishop, New London	28.00	18.24
			J. M. Burke, So. Manchester	33.00	----
				30.50	----
12513	Bowker's Potato and Vegetable	Bowker Fertilizer Co., Boston, Mass.	Bowker's Branch, Hartford	**33.00**	19.65
12353*	Potato Manure	Quinnipiac Co., Boston, Mass.	C. Buckingham, Southport	28.00	18.39
			Olds & Whipple, Hartford	33.00	----
				31.00	----
12406	Corn Fertilizer	M. E. Wheeler & Co., Rutland, Vt.	G. C. Ingham, Saybrook	25.00	15.37
			Dwight Gallup, Old Mystic	27.00	----
			D. G. Chesebro, Center Groton	**26.00**	----
12212	Standard Special for Potatoes	Standard Fertilizer Co., Boston	H. F. Child, Woodstock	**30.00**	17.45
12345	Potato Manure	Bradley Fertilizer Co., Boston	D. L. Clark, Milford	30.00	17.92
			Kinsella & Smallhorn, New Canaan	32.00	----
				31.00	----
12495	Havana Tobacco Grower	M. E. Wheeler & Co., Rutland, Vt.	John Bransfield, Portland	40.00	22.18
			E. E. Pitney, Ellington	37.00	
				38.50	

* See note, page 63.

Analyses and Valuations—*Continued.*

Station No.	Percentage difference between cost and valuation.	Nitrogen					Phosphoric Acid.							Potash.		
		Nitrogen as Nitrates.	Nitrogen as Ammonia.	Nitrogen, Organic.	Total Nitrogen. Found.	Total Nitrogen. Guaranteed.	Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Found. As Muriate.	Found.	Guaranteed.
12377	63.8	.71	----	1.86	2.57	*2.5*	3.04	4.49	2.21	9.74	*7.0*	7.53	*6.0*	4.83	4.83	*5.0*
12393	64.3	.26	----	1.90	2.16	*2.7*	5.65	3.33	2.80	11.78	*11.0*	8.98	*9.0*	3.30	3.30	*3.3*
12388	64.5	.15	----	1.89	2.04	*2.0*	6.91	3.01	2.00	11.92	*11.0*	9.92	*9.0*	2.97	2.97	*3.0*
12394	64.5	.32	----	2.00	2.32	*2.0*	5.84	3.24	2.38	11.46	*10.0*	9.08	*9.0*	2.14	2.14	*1.5*
12401	64.8	.40	----	2.10	2.50	*2.0*	3.84	6.93	3.20	13.97	*11.0*	10.77	----	3.36	3.36	*3.0*
12430	67.2	----	.30	1.45	1.75	*1.7*	7.02	2.20	1.97	11.19	*10.0*	9.22	*8.0*	.40	4.17	*4.0*
12499	67.2	.26	----	1.95	2.21	*2.1*	6.59	3.32	2.12	12.03	*9.0*	9.91	*8.0*	3.16	3.16	*3.0*
12513	67.9	.38	----	2.18	2.56	*2.3*	7.57	2.36	.89	10.82	*11.0*	9.93	*9.0*	4.16	4.16	*4.0*
12353*	68.6	.68	----	1.94	2.62	*2.5*	3.18	4.37	2.33	9.88	*7.0*	7.55	*6.0*	4.67	4.67	*5.0*
12406	69.2	----	----	1.80	1.80	*1.6*	6.72	2.44	.95	10.11	*8.0*	9.16	*8.0*	2.29	2.29	*2.0*
12212	71.9	.35	----	1.83	2.18	*2.1*	5.38	3.16	3.23	11.77	*9.0*	8.54	*8.0*	3 28	3.28	*3.0*
12345	73.0	.68	----	1.82	2.50	*2.0*	3.89	2.45	2.49	8.83	*8.0*	6.34	*6.0*	5.48	5.48	*5.0*
12495	73.6	----	----	3.17	3.17	*2.9*	4.99	2.57	1.02	8.58	----	7.56	*6.0*	3.33	6.84	*7.0*

* See note, page 63.

Special Manures Sampled by the Station.

Station No.	Name of Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
12540	Grass and Oat Phosphate	Great Eastern Fertilizer Co., Rutland, Vt.	H. S. Harvey, Windham	$20.00	$11.50
12663	High Grade Potato Fertilizer	E. Frank Coe Co., New York	J. O. Fox & Co., Putnam	38.00	21.80
12376	Bowker's Corn Phosphate	Bowker Fertilizer Co., Boston	H. E. Kelsey, Westbrook	30.00	16.89
			Lewis Dowd, Madison	30.00	----
12434	Corn Phosphate	Bradley Fertilizer Co., Boston	G. W. Eaton, Bristol	31.00	16.87
			S. J. Stevens, Glastonbury	30.00	----
12390	Animal Corn Fertilizer	Packer's Union Fertilizer Co., N. Y.	O. S. Rogers, Essex	33.00	17.58
			Nelson Dayton, New London	30.00	----
				31.50	----
12410	Bowker's Potato and Vegetable Phosphate	Bowker Fertilizer Co., Boston	H. E. Kelsey, Westbrook	34.00	16.63
			Linsley & Lightbourn, New Haven	35.00	----
				30.00	----
12607	Potato Phosphate	Berkshire Mills Co., Bridgeport	Z. J. Hinman, Collinsville	32.00	17.71
			J. W. Palmer, Stamford	32.00	----
			Manufacturer	----	----
12496	Ammoniated Corn Phosphate	Crocker Fertilizer and Chemical Co., Buffalo, N. Y.	F. M. Loomis, North Granby	34.00	17.15
			C. F. Tallard & Son, Broad Brook	28.00	----
				31.00	----
12478	Special Potato Fertilizer	Milsom Rend. & Fert. Co., E. Buffalo, N. Y.	G. W. Barnes, Poquonock	34.00	16.77
			C. H. Davis, Guilford	31.00	----
12582	Good Grower Potato Phosphate	Williams & Clark Fertilizer Co., New York	S. G. Brown, Norfolk	28.00	15.10
12484	Corn Fertilizer	Milsom Rend. & Fert. Co., E. Buffalo, N. Y.	C. H. Davis, Guilford	28.50	15.92
			G. W. Barnes, Poquonock	31.00	----
				29.75	----
12470	Corn Manure	Quinnipiac Co., Boston	S. V. Osborne, Branford	32.00	17.07
			R. B. Witter, Brooklyn	----	----
12535	High Grade Tobacco Manure	Bradley Fertilizer Co., Boston	Loomis Bros., Granby	45.00	23.90
12472	Special for Potatoes	Standard Fertilizer Co., Boston	W. B. Chamberlain & Son, Colchester	----	17.67
			J. W. Howe & Son, So. Glastonbury	34.00	----
12645	Grass and Grain Fertilizer	Pacific Guano Co., Boston	Carlos Bradley, Ellington	24.00	12.47

Analyses and Valuations—*Continued.*

Station No.	Percentage difference between cost and valuation.	Nitrogen.					Phosphoric Acid.							Potash.		
		Nitrogen as Nitrates.	Nitrogen as Ammonia.	Nitrogen, Organic.	Total Nitrogen.		Soluble.	Reverted.	Insoluble.	Total.		Available.		Found.		Guaranteed.
					Found.	Guaranteed.				Found.	Guaranteed.	Found.	Guaranteed.	As Muriate.	Total.	
12540	73.9	----	----	----	----	----	4.37	6.98	.93	12.28	----	11.35	*11.0*	1.90	1.90	*2.0*
12663	74.3	.38	.16	2.09	2.63	*2.4*	6.28	2.06	1.70	10.04	*9.0*	8.34	*7.0*	.17	6.57	*6.5*
12376	77.6	.15	----	1.74	1.89	*1.5*	7.76	2.84	1.36	11.96	*10.0*	10.60	*8.0*	2.18	2.18	*2.0*
12434	77.8	----	----	2.15	2.15	*2.1*	6.50	3.22	2.19	11.91	*10.0*	9.72	*9.0*	1.81	1.81	*1.5*
12390	79.2	----	----	2.58	2.58	*2.5*	6.50	2.83	.98	10.31	----	9.33	*8.0*	2.19	2.19	*2.0*
12410	80.4	.20	----	1.67	1.87	*1.5*	7.10	3.17	1.68	11.95	*11.0*	10.27	*9.0*	2.18	2.18	*2.0*
12607	80.7	----	----	2.07	2.07	*1.6*	3.10	3.90	4.85	11.85	*8.0*	7.00	*6.0*	4.78	4.78	*4.0*
12496	80.8	----	----	2.08	2.08	*2.0*	7.36	3.75	1.22	12.33	----	11.11	*10.0*	1.43	1.43	*1.6*
12478	84.9	----	----	1.64	1.64	*1.6*	4.58	2.58	1.41	8.57	*10.0*	7.16	*8.0*	6.40	6.40	*8.0*
12582	85.4	----	----	1.45	1.45	*1.2*	4.72	2.55	1.42	8.69	*7.0*	7.27	*6.0*	4.92	4.92	*5.0*
12484	86.9	----	----	2.40	2.40	*2.5*	5.10	2.66	1.92	9.68	*9.0*	7.76	*8.0*	2.01	2.01	*2.0*
12470	87.5	.38	----	1.94	2.32	*2.0*	5.87	3.57	2.62	12.06	*10.0*	9.44	*9.0*	1.76	1.76	*1.5*
12535	88.3	----	3.97	1.85	5.82	*5.8*	1.25	4.53	1.81	7.59	*6.0*	5.78	*5.0*	1.58	10.48	*10.0*
12472	92.4	.21	----	1.91	2.12	*2.1*	6.19	3.14	2.11	11.44	*9.0*	9.33	*8.0*	3.38	3.38	*3.0*
12645	92.5	----	----	1.17	1.17	*0.8*	5.42	2.85	1.73	10.00	*8.0*	8.27	*7.0*	1.58	1.58	*1.1*

Special Manures Sampled by the Station.

Station No.	Name of Brand.	Manufacturer.	Dealer.	Dealer's cash price per ton.	Valuation per ton.
12447	Wheat and Corn Producer	Niagara Fertilizer Works, Buffalo, N. Y.	W. R. Atwell, Durham	$28.00	$14.39
			H. A. Kinne, So. Glastonbury	28.00	----
12407	Oats and Clover Fertilizer	Packer's Union Fertilizer Co., New York	O. S. Rogers, Essex	24.00	11.29
			A. S. Bennett, Cheshire	21 00	----
				22.00	----
12630	Potato, Hop and Tobacco	Milsom Rend. and Fert. Co., E. Buffalo, N. Y.	George D. Fairchild, Bloomfield	31.50	15.88
12483†	Potato, Hop and Tobacco	Milsom Rend. and Fert. Co., E. Buffalo, N. Y.	Chas. H. Davis, Guilford	29.50	15.53
			G. W. Barnes, Poquonock	32.00	----
				31.00	----
12653	Wheat, Oats and Barley Phosphate	Milsom Rend. and Fert. Co., E. Buffalo, N. Y.	J. R. Gilbert, Gilead	----	12.28
				25.00	
12649	Potato Special	Pacific Guano Co., Boston	J. O. Fox & Co., Putnam	36.00	17.58
12446	Potato, Tobacco and Hop Fertilizer	Niagara Fertilizer Works, Buffalo, N. Y.	H. A. Kinne, So. Glastonbury	33.00	14.66
			W. R. Atwell, Durham	33.00	

† See page 63.

2. *Sampled by Private Individuals.*

12281. Ten Per Cent. Potato Fertilizer, made by the Preston Fertilizer Co., Brooklyn, N. Y. Sampled and sent by O. G. Beard, Shelton.

12445. Tobacco Ash Elements, made by the Bowker Fertilizer Co., Boston, Mass. Sampled and sent by H. M. Rose, West Suffield.

Analyses and Valuations—*Continued.*

Station No.	Percentage difference between cost and valuation.	Nitrogen					Phosphoric Acid.							Potash.		
		Nitrogen as Nitrates.	Nitrogen as Ammonia.	Nitrogen, Organic.	Total Nitrogen. Found.	Total Nitrogen. Guaranteed.	Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Found. As Muriate.	Found. Total.	Guaranteed.
12447	94.6	----	----	1.56	1.56	*1.2*	4.82	3.88	1.87	10.57	----	8.70	*8.0*	2.15	2.15	*2.2*
12407	94.9	----	----	----	----	----	4.96	6.13	1.20	12.29	----	11.09	*11.0*	1.71	1.71	*2.0*
12630	98.4	----	.12	1.94	2.06	*2.1*	4.28	3.26	1.15	8.69	*9.0*	7.54	*8.0*	3.73	3.73	*4.0*
12483†	99.6	----	----	2.06	2.06	*2.1*	4.86	2.55	1.51	8.92	*9.0*	7.41	*8.0*	3.24	3.24	*4.0*
12653	103.6	----	----	1.29	1.29	*1.2*	4.88	2.88	1.34	9.10	----	7.76	*8.0*	1.69	1.69	*2.0*
12649	104.8	.24	----	2.00	2.24	*2.0*	4.32	4.42	3.53	12.27	*9.0*	8.74	*8.0*	2.99	2.99	*3.0*
12446	125.1	----	----	1.67	1.67	*1.6*	4.80	3.31	.85	8.96	*8.0*	8.11	*8.0*	3.14	3.14	*2.7*

† See page 63.

Analyses and Valuations.

	12281	12445
Nitrogen as nitrates	0.34	....
" organic	1.89	....
" total	2.23	....
Soluble phosphoric acid	4.13	trace.
Reverted phosphoric acid	6.36	8.57
Insoluble phosphoric acid	3.68	2.52
Total phosphoric acid	14.17	11.09
Potash as muriate	9.24	1.80
Potash, total	9.24	15.13
Cost per ton	$30.00	$30.00
Valuation per ton	24.27	22.73

HOME MIXTURES. FORMULAS AND

Station No.	Made by	Formulas. Pounds per ton of Mixture.								
		Nitrate of Soda.	Tankage.	Blood, Bone and Meat.	Dry Ground Fish.	Bone.	Dissolved Bone Black.	Dissolved Rock Phosphate.	Sulphate of Potash.	Muriate of Potash.
12178	S. D. Woodruff & Sons, Orange	100	800	----	----	----	----	800	----	300
12298	A. C. Innis, Stratford	200	1200	----	----	----	200	----	----	400
12341	J. H. Blakeman, Oronoque	----	833	----	----	----	----	833	----	334
12342	J. G. Schwink, Meriden	100	750	----	----	----	----	750	200	200
12372	F. T. Bradley, Saybrook	----	1400	----	----	----	----	200	----	400
12462	Hiram B. Atwood, Watertown	150	800	----	----	----	----	650	----	400
12568	N. D. Platt, Milford	167	----	666	----	167	666	----	----	334
12676	H. G. Goldsmith, Branford	----	----	----	800	800	----	----	----	400

HOME MIXTURES.

In the table just above, are given the analyses and valuations of eight mixtures made by farmers according to formulas given in the table from fertilizer chemicals bought by them. The cost does not include the outlay for mixing these chemicals, which is usually estimated at two or three dollars per ton. The average cost per ton is $26.55, or, including mixing, $29.50 at the most. The average valuation is $26.61 per ton, and the percentage difference between cost, mixing included, and valuation is 10.9.

The mixing is often a rainy day job that employs labor otherwise idle and thus has the quality of "a penny saved" which "is twopence earned."

MISCELLANEOUS FERTILIZERS AND MANURES.

Cotton Hull Ashes.

In the table, pages 82 to 83, are given analyses of thirty-six samples of cotton hull ashes; which are extensively used as a source of potash for fertilizing tobacco lands where "Connecticut Havana" wrapper leaf is raised, in the Connecticut River valley.

These analyses show the usual wide range of composition.

Analyses and Valuations.

Analyses.								Cost (Unmixed) and Valuation.	
Nitrogen as Nitrates.	Organic Nitrogen.	Total Nitrogen.	Soluble Phosphoric Acid.	Reverted Phosphoric Acid.	Insoluble Phosphoric Acid.	Total Phosphoric Acid.	Potash.	Cost per ton.	Valuation per ton.
0.78	3.11	3.89	5.06	3.52	2.58	11.16	7.36	$26.00	$25.32
1.60	3.38	4.98	1.87	5.41	5.27	12.55	11.31	35.00	31.19
0.14	2.62	2.76	3.01	5.82	3.71	12.54	9.93	20.00	24.98
0.80	2.64	3.44	4.08	3.31	2.87	10.26	7.96	22.00	23.71
----	5.35	5.35	1.25	3.60	2.39	7.24	11.15	35.00	29.43
1.21	2.08	3.29	5.01	3.34	1.95	10.30	10.49	23.55	25.73
0.98	2.87	3.85	3.89	5.45	2.28	11.62	7.49	27.00	25.63
	3.20	3.54*	0.38	8.80	1.57	10.75	8.82	25.20	25.49

* 0.34 per cent. of nitrogen as ammonia.

The highest percentage of water-soluble potash found was 30.94, the lowest 11.10 (excluding this, the lowest is 16.96) and the average, 22.62, slightly lower than in the previous year, (23.3.)

Allowing 4½, 4 and 2 cents per pound respectively for water-soluble, citrate-soluble and insoluble phosphoric acid, the water-soluble potash has cost from 4.2 cents to 7.3 cents per pound, or 6.7 cents per pound on the average, a little less than in the previous year, (7.1).

Purchasers are urged to insist on a guarantee of water-soluble potash. Samples often contain from one to five per cent. of potash insoluble in water and presumably but slowly available to plants.

In seven of the samples received, the total potash as well as water-soluble potash was determined with the following results:

Percentages of Water-Soluble and of Total Potash in Samples of Cotton Hull Ashes.

Station No.	Water-Soluble Potash.	Total Potash.	Potash Insoluble in Water.
12444	24.34	26.92	2.58
12381	21.98	25.02	3.04
12187	21.18	24.20	3.02
12358	19.70	22.20	2.50
12319	22.90	24.18	1.28
12185	19.14	22.48	3.34
12317	20.58	25.82	5.24

Cotton Hull Ashes.

Station No.	Dealer or Purchaser.	Supplied by
12670	C. C. Fuller, New York	Comstock, Ferre & Co., Wethersfield
12042	Olds & Whipple, Hartford	R. A. Parker, Warehouse Point
12272	American Cotton Oil Co., New York	T. P. Kinney, Windsor
12277	Olds & Whipple, Hartford	A. E. Holcomb, Poquonock
12444	Arthur Sikes, Suffield	A. F. Austin, Suffield
12271	Olds & Whipple, Hartford	O. C. Rose, West Suffield
12792	Olds & Whipple, Hartford, by H. C. Aborn & Son, Ellington	Station Agent
12323	W. F. Fletcher, Southwick, Mass.	John B. Cannon, W. Suffield
12381	Arthur Sikes, Suffield	G. A. Douglass, Thompsonville
12187	" " "	Chas. H. Wells, Suffield
12182	W. W. Cooper, "	Alanson Hoffman, West Suffield
12358	Arthur Sikes, "	Ernest N. Austin, Suffield
12043	Olds & Whipple, Hartford, by T. P. Kinney, Windsor	Station Agent
12186	Ariel Mitchelson, Tariffville	Alfred H. Griffin, Granby
12529	----------	C. Dwyer, Bloomfield
12363	Humphreys, Goodwin & Co., Memphis, Tenn.	S. A. Kent, Suffield
12031	Wm. S. Pinney, Suffield	Station Agent
12530	----------	Chas. Dwyer, Bloomfield
12505	P. L. Spencer, Suffield	F. B. Hatheway, Windsor Locks
12320	Olds & Whipple, Hartford	W. S. Pinney, Suffield
12362	Chas. L. Spencer	E. S. Seymour, Windsor Locks
12319	J. C. Eddy, Simsbury	D. L. Brockett, Suffield
12458	Planters' Cotton Seed & Crushing Ass'n, Greenville, Miss.	T. Soule & Co., New Milford
10857	Edmund Halladay, Suffield	Edmund Halladay, Suffield
12164	Loomis Bros., Granby	D. A. Merriam, Granby
12475	W. W. Cooper, Suffield	Station Agent
12459	W. S. Pinney, "	W. H. Prout, Suffield
12382	" " "	G. A. Douglass, Thompsonville
12027	----------	Chas. C. Bissell, Suffield
12185	Arthur Sikes, Suffield	Edward Austin, Mapleton
12506	Wm. Pinney, "	C. D. Woodworth, Thompsonville
12317	Olds & Whipple, Hartford	Station Agent
12610	" " "	F. L. Chandler, South Windsor
12364	W. W. Cooper, Suffield	O. A. Hazard, Suffield
12028	----------	Chas. C. Bissell, "
12383	C. C. Fuller, New York	" " "

Analyses.

Station No.	Soluble Phosphoric Acid.	Reverted Phosphoric Acid.	Insoluble Phosphoric Acid.	Total Phosphoric Acid.	Potash Soluble in Water.	Cost per ton.	Valuation per ton.	Potash costs cents per pound.
12670	.04	2.48	.84	3.36	11.10	$11.60	$13.46	4.2
12042	2.96	8.17	.22	11.35	30.94	40.00	40.23	5.0
12272	4.27	7.45	.69	12.41	29.72	40.00	39.80	5.0
12277	4.26	7.54	.57	12.37	29.14	40.00	39.23	5.1
12444	2.62	6.02	.55	9.19	24.34	32.50	31.74	5.2
12271	3.70	5.50	.73	9.93	27.32	40.00	35.34	5.9
12792	1.12	5.46	.62	7.20	28.23	40.00	33.86	6.1
12323	1.23	6.24	.65	8.12	24.40	36.00	30.76	6.1
12381	2.82	6.73	.70	10.25	21.98	35.00	30.18	6.1
12187	1.74	6.15	.87	8.76	21.18	32.50	28.02	6.1
12182	1.25	7.44	.71	9.40	26.16	40.00	33.52	6.2
12358	1.50	7.05	1.01	9.56	19.70	32.50	27.09	6.4
12043	1.86	7.91	.76	10.53	24.20	40.00	32.50	6.5
12186	.61	7.84	.70	9.15	22.08	36.00	29.18	6.5
12529	1.39	4.44	.16	5.99	25.04	38.00	29.90	6.6
12363	.66	5.72	.55	6.93	22.28	35.00	27.67	6.6
12031	2.00	7.24	.97	10.21	24.12	40.00	32.10	6.6
12530	.74	7.64	.28	8.66	23.24	38.00	30.13	6.7
12505	1.02	7.37	.53	8.92	24.38	40.00	31.41	6.8
12320	1.02	6.26	1.19	8.47	20.63	35.00	27.04	6.9
12362	1.23	8.25	1.01	10.49	22.56	40.00	30.67	7.1
12319	1.73	6.78	.76	9.27	22.90	40.00	30.18	7.1
12458	1.23	5.23	.93	7.39	20.56	35.00	26.22	7.1
10857	.54	8.06	.75	9.35	21.26	38.00	28.50	7.2
12164	1.38	8.74	.95	11.07	20.36	38.00	28.97	7.2
12475	.91	6.25	.52	7.68	22.00	38.00	28.03	7.3
12459	1.36	8.45	.86	10.67	21.84	40.00	30.16	7.3
12382	1.31	8.36	.78	10.45	21.48	40.00	29.66	7.4
12027	1.33	10.13	.46	11.92	20.70	40.00	30.18	7.4
12185	1.04	5.52	1.10	7.66	19.14	35.00	24.94	7.6
12506	.94	7.46	.90	9.30	21.14	40.00	28.32	7.8
12317	.30	7.50	1.03	8.83	20 58	40.00	27.26	8.1
12610	.48	5.18	.76	6.42	21.42	40.00	26.29	8.2
12364	.45	5.58	.87	6.90	18.72	40.00	23.94	9.3
12028	.50	8.41	.77	9.68	16.96	40.00	24.45	9.6
12383	.75	8.24	.71	9.70	18.54	----	26.09	----

WOOD ASHES.

In the following table are given analyses of twelve samples of wood ashes.

Sample **14010** is from the pits in the smoke house of the Hoyt Provision Co. of New Haven.

Sample **12061** represents wood ashes from the furnaces of a Waterbury Brass Mill.

Sample **14020** was analyzed in due course, but the form containing the description of the sample, with name and address of the sender, could not be found when the analysis was completed. It is hoped that this may meet the eye of the person who sent it and explain to him our failure to make prompt report to him of the analysis.

The eight analyses of "Canada Ashes" given in the table contain on the average 4.63 per cent. of water-soluble potash, 1.54 per cent. of phosphoric acid and 33.57 per cent of lime, or about 59.5 per cent. of carbonate of lime.

The lime contained in ashes is often their most valuable ingredient for agricultural purposes. A ton of unleached wood ashes, calculated from the average of the analyses given above, contains 671 pounds of lime, 93 pounds of potash, and

SOURCES, ANALYSES AND COST OF

Station No.	Dealer or Purchaser.	Sampled or sent by
	Unleached Ashes.	
10856	Bowker Fertilizer Co., Boston	N. D. Platt, Milford
12457	Bowker Fertilizer Co., Boston, by H. B. Sherwood, Southport	Station Agent
12616	Bowker Fertilizer Co., Boston, by Simeon Pease, Greenfield Hill	H. C. C. Miles, Milford
12300	Geo. Munroe, Oswego, N. Y.	Conn. Valley Orchard Co., Deep River
12327	Geo. Munroe, Oswego, N. Y., by Conn. Valley Orchard Co., Berlin	Earl Cooley, Berlin
12531	Geo. Munroe, Oswego, N. Y., by Newell St. John, Simsbury	Station Agent
12502	Warren Woolen Co., Stafford Springs, by Chas. Sikes, Jr., Ellington	Station Agent
12793		S. R. Woodward, Bethany
14020		
14010	Hoyt Provision Co., New Haven	Elm City Nursery Co., New Haven
12061	"Brass Mill"	The Everett B. Clark Co., Milford
	Leached Ashes.	
10855	B. A. Jackson, South Norwalk	Geo S. Jennings, Southport

3 pounds of phosphoric acid, costing $9.41. Allowing 5 cents per pound each for potash and phosphoric acid, the pure lime (calcium oxide) in the nine samples has cost forty-eight cents for 100 pounds.

Ashes are sometimes sold with a guarantee of 5.0 per cent. of "potash." This Station, as a rule, determines only the potash soluble in water; for the reason that only potash which is freely soluble can be regarded as immediately available to vegetation. Green sand marl, feldspar, and glass all may contain considerable quantities of "potash," but in forms which yield it up to the roots of plants extremely slowly.

Sample **12793** contained only 3.84 per cent. of water-soluble potash and 0.53 per cent. of potash insoluble in water, but dissolved by strong acids; making the total potash present 4.37 per cent.

In the table is given a single analysis, **10855,** of leached wood ashes, having the usual composition, 0.15 per cent. of water-soluble potash, 0.87 per cent. of phosphoric acid, 43 per cent. of carbonate of lime and nearly 30 per cent. of water. Mr. Jennings states that this was bought for unleached ashes for $7.00 per ton with a guarantee of 4-5 per cent. of potash.

WOOD ASHES.

Potash Soluble in Water.	Phosphoric Acid.	Lime, Calcium Oxide.	Carbonic Acid.	Sand and Soil.	Charcoal.	Cost per ton.
4.78	1.97	40.17	27.93	9.13	1.23	$ ----
4.65	1.59	28.48	19.95	11.82	1.61	10.00
4.35	1.57	29.42	19.88	12.08	1.45	10.00
4.98	1.34	31.40	21.67	10.65	1.23	9.50
4.66	1.28	31.56	18.78	10.38	1.44	10.00
5.90	1.36	29.14	17.54	12.89	2.09	10.00
3.85	1.79	46.88	20.57	4.09	1.86	7.00
3.84	1.39	31.52	20.57	10.96	1.86	7.00
1.04	.54	48.57	23.94	3.16	2.03	----
4.93	.92	33.28	24.08	10.21	6.66	----
4.32	2.83	42.60	24.77	5.68	1.15	----
0.15	0.87	23.67	19.70	8.36	2.36*	----

* Also contains 29.74 per cent. water.

REVIEW OF THE FERTILIZER MARKET.

For the Year Ending October 31, 1899.

By E. H. Jenkins.

Nitrogen.

Nitric Nitrogen.

The *wholesale* New York quotation of nitrogen in form of nitrate of soda was 9.9 cents per pound in November, 1898. It rose gradually to 10.7 cents in April, 1899, fell again to 10.4 in August and rose to 10.9 cents in October.

The average of the monthly quotations for a number of years—from November 1st to November 1st, has been as follows:

Year	1899	1898	1897	1896	1895	1894	1893	1892
Average quotation, cents per pound for nitrogen, *wholesale*	10.5	11.0	11.4	11.1	11.4	13.0	12.7	12.1

Nitrate nitrogen has sold at *retail* in the State for from 12.6 to 14.5 cents per pound, or from $40 to $45 per ton for nitrate of soda.

Ammonic Nitrogen.

The *wholesale* New York quotation of nitrogen in sulphate of ammonia was 12.6 cents per pound in November, 1898. It rose gradually to 15.3 cents in June, 1899, and fell again to 14.3 cents in October. The average of the monthly quotations for the year, November 1st to November 1st, has been 14 cents per pound.

The corresponding averages of previous years have been:

Year	1899	1898	1897	1896	1895	1894	1893	1892
Average quotation, cents per pound for nitrogen, *wholesale*	14.0	11.9	10.5	11.1	14.3	17.3	15.7	14.5

Scarcely any sulphate of ammonia is bought by farmers in this State in unmixed goods, because with the high and fluctu-

ating prices it is not thought to be so economical to use as nitrate of soda or organic forms of nitrogen.

Organic Nitrogen.

The *wholesale* New York quotations of nitrogen in the forms of red blood, black or low grade blood and concentrated tankage are given in the table on page 91, and show only slight fluctuations.

Dried blood has not been largely sold *at retail* in the Connecticut market. The single sample analyzed, page 23, contained 13.68 per cent. of nitrogen, which cost 14.1 cents per pound.

Low grade tankage, fish, bone and especially cotton seed meal are the forms most popular with those who buy fertilizer materials unmixed at retail. Dry fish has been a cheap form of organic nitrogen during the past year.

In cotton seed meal nitrogen has cost at retail 12.9 cents per pound.

Phosphatic Materials.

The *wholesale* price of ground bone and bone meal have advanced during the year by $1.75 and $2.50 per ton respectively. Charleston rock has risen by about twenty-five cents per ton, while bone black has fallen slightly.

The wholesale quotation of acid phosphate remained the same through the year until October.

The figures given on page 27 show that *at retail,* available phosphoric acid has cost in dissolved bone black from 5.9 to 7.0 cents per pound and in dissolved rock phosphate from 3.7 to 6.1 cents per pound.

Potash.

The prices of potash salts, which are regulated by the German Kali Works, show little fluctuation.

Muriate of Potash.

Potash in this form cost, at wholesale, in New York, 3.64 cents per pound in October, 1898, and is now quoted at 3.58 cents.

The average *retail* price in Connecticut, during the year covered by this review, has been 4.2 cents per pound.

Double Sulphate of Potash and Magnesia.

At wholesale in New York, potash in this form cost 4.11 cents per pound in November, 1898, and it is now quoted at 3.91 cents.

Its *retail* cost in Connecticut has been about 5.5 cents.

High Grade Sulphate of Potash.

At *wholesale,* in New York, potash in this form cost 4.09 cents in November, 1898, and it has since fallen to 4.07 cents.

The *retail* cost of potash in this form has been about five cents per pound.

There are two other forms of potash, much used on tobacco lands, which are worth the attention of all farmers. Cotton hull ashes, when of good quality, contain over twenty per cent. of potash, *chiefly in form of carbonate,* and eight to ten per cent. of phosphoric acid. At present prices actual potash costs more in this material than in the Stassfurt Salts, but as the ashes are strongly alkaline their use may be found very profitable on lands which have been dressed for some time with chemical fertilizers, and on meadows having acid soils.

The second form of potash fertilizers is tobacco stems, which contain eight per cent. or more of potash together with two per cent. of nitrogen and one per cent. of phosphoric acid.

EXPLANATIONS OF MARKET QUOTATIONS.

The following explanations will help in the examination of the market quotations, and will also show the basis on which they have been interpreted in this review:

Phosphate rock, kainit, bone, fish-scrap, tankage, and some other articles, are usually quoted and sold by the ton. The seller usually has an analysis of his stock, and purchasers often control this by analysis at the time of the purchase.

Sulphate of ammonia, nitrate of soda and the potash salts are quoted and sold by the pound, and generally their wholesale and retail rates do not differ very widely.

Blood, azotin, and concentrated tankage are quoted at so much "per unit of ammonia." To reduce ammonia to nitrogen, multiply the per cent. of ammonia by the decimal .824 (or multiply the per cent. of ammonia by 14 and divide that product by 17). A "unit of ammonia" is one per cent., or 20 pounds per ton. To illustrate: if a lot of tankage has 7.0 per cent. of nitrogen, equivalent to 8.5 per cent. of ammonia, it is said to contain 8½ units of ammonia, and if quoted at $2.25 per unit, a ton of it will cost $8\frac{1}{2} \times 2.25 = \$19.13$.

The term "ammonia" is *properly* used only in those cases where the nitrogen actually exists in the form of ammonia, but it is a usage of the trade to reckon all nitrogen, in whatever form it occurs, as ammonia.

To facilitate finding the actual cost of nitrogen per pound from the cost per unit of ammonia in the market reports, the following table is given:

Ammonia at	$3.00	per unit	is equivalent to	nitrogen at	18.2	cts.	per lb.
"	2.90	"	"	"	17.6	"	
"	2.80	"	"	"	17.0	"	
"	2.70	"	"	"	16.4	"	
"	2.60	"	"	"	15.8	"	
"	2.50	"	"	"	15.2	"	
"	2.40	"	"	"	14.6	"	
"	2.30	"	"	"	14.0	"	
"	2.20	"	"	"	13.4	"	
"	2.10	"	"	"	12.8	"	
"	2.00	"	"	"	12.2	"	
"	1.90	"	"	"	11.6	"	
"	1.80	"	"	"	11.0	"	
"	1.70	"	"	"	10.3	"	
"	1.60	"	"	"	9.7	"	
"	1.50	"	"	"	9.1	"	

Commercial sulphate of ammonia contains about 20.8 per cent. of nitrogen, though it varies somewhat in quality. With that per cent. of nitrogen (equivalent to 25.25 per cent. of ammonia),

If quoted at	2.6	cents	per pound,	Nitrogen costs	12.5	cents	per pound.
"	2.5	"	"	"	12.0	"	
"	2.4	"	"	"	11.5	"	
"	2.3	"	"	"	11.1	"	
"	2.2	"	"	"	10.6	"	
"	2.1	"	"	"	10.1	"	
"	2.0	"	"	"	9.6	"	

Commercial nitrate of soda averages 95 per cent. of pure sodium nitrate, or 16 per cent. of nitrogen.

If quoted at	2.5	cents per pound,	Nitrogen	costs	15.6	cents per pound.
"	2.4	"	"	"	15.0	"
"	2.3	"	"	"	14.4	"
"	2.2	"	"	"	13.8	"
"	2.1	"	"	"	13.2	"
"	2.0	"	"	"	12.5	"
"	1.9	"	"	"	11.9	"
"	1.8	"	"	"	11.3	"
"	1.7	"	"	"	10.6	"
"	1.6	"	"	"	10.0	"
"	1.5	"	"	"	9.4	"

Commercial Muriate of Potash usually contains 50½ per cent. of "actual potash," or potassium oxide.

If quoted at	2.20	cents per pound,	Potassium oxide	costs	4.35	cents per lb.
"	2.15	"	"	"	4.25	"
"	2.10	"	"	"	4.15	"
"	2.05	"	"	"	4.06	"
"	2.00	"	"	"	3.96	"
"	1.95	"	"	"	3.86	"
"	1.90	"	"	"	3.76	"
"	1.85	"	"	"	3.66	"
"	1.80	"	"	"	3.56	"
"	1.75	"	"	"	3.46	"
"	1.70	"	"	"	3.36	"

High Grade Sulphate of Potash, as it is found in the Connecticut market, contains about 49.2 per cent. of actual potash.

If quoted at	2.50	cents per pound,	Potassium oxide	costs	5.1	cents per lb.
"	2.45	"	"	"	5.0	"
"	2.40	"	"	"	4.9	"
"	2.35	"	"	"	4.8	"
"	2.30	"	"	"	4.7	"
"	2.25	"	"	"	4.6	"
"	2.20	"	"	"	4.5	"
"	2.15	"	"	"	4.4	"
"	2.10	"	"	"	4.3	"
"	2.05	"	"	"	4.2	"
"	2.00	"	"	"	4.1	"

The Double Sulphate of Potash and Magnesia has about 26½ per cent. of potassium oxide.

If quoted at	1.00	cents per pound,	Potassium oxide	costs 3.77	cents per lb.
"	1.05	"	"	" 3.96	"
"	1.10	"	"	" 4.15	"
"	1.15	"	"	" 4.34	"
"	1.20	"	"	" 4.53	"
"	1.25	"	"	" 4.72	"
"	1.30	"	"	" 4.90	"

The following table shows the fluctuations in the wholesale prices of a number of fertilizing materials in the New York market, since November, 1894. The price given for each month is the average of the four weekly quotations for that month. Sulphate of ammonia is assumed to contain 20.8 per cent. and nitrate of soda 16.0 per cent. of nitrogen, muriate of potash 50½ per cent., high grade sulphate 49.2 per cent., and double manure salt 26.5 per cent. of actual potash.

Wholesale Prices of Fertilizing Materials.

		Cost of Nitrogen at wholesale in					Cost of Potash at wholesale in			
		Dried Blood.								
		Red. Cents per pound.	Black or low grade. Cents per pound.	Concentrated Tankage. Cents per pound.	Nitrate of Soda. Cents per pound.	Sulphate of Ammonia. Cents per pound.	Muriate of Potash. Cents per pound.	Double Manure Salt. Cents per pound.	High Grade Sulphate of Potash. Cents per pound.	Available Phosphoric Acid in Dissolved South Carolina Rock. Cents per pound.
1895.	November	11.7	9.9	12.3	11.6	12.0	3.60	4.32	4.34	2.62
	December	11.7	9.8	12.3	11.1	12.0	3.60	4.32	4.34	2.62
1896.	January	11.0	9.8	12.3	10.8	11.6	3.60	4.32	4.34	2.62
	February	10.8	9.8	12.3	10.7	11.3	3.55	3.99	4.13	2.62
	March	10.8	9.8	12.3	10.7	11.5	3.53	3.87	4.05	2.73
	April	10.8	9.8	12.3	10.7	11.1	3.60	3.94	4.10	2.73
	May	10.7	9.9	12.3	10.9	10.8	3.60	3.94	4.10	2.73
	June	10.5	9.8	12.3	10.8	10.8	3.60	3.94	4.10	2.73
	July	10.5	9.8	12.6	10.8	10.8	3.60	3.94	4.10	2.73
	August	10.5	9.8	11.4	10.8	10.7	3.60	3.94	4.10	2.73
	September	10.2	9.1	9.5	10.8	10.5	3.60	3.94	4.10	2.73
	October	10.3	9.0	9.5	11.3	10.5	3.60	3.94	4.10	2.73
	November	11.0	10.1	9.4	11.6	10.8	3.59	3.94	4.10	2.73
	December	11.2	10.8	9.5	12.1	10.4	3.59	3.94	4.10	2.73
1897.	January	10.7	10.1	9.4	12.1	11.0	3.59	3.94	4.10	2.73
	February	10.6	10.0	9.4	11.9	11.0	3.59	3.94	4.10	2.73
	March	10.5	10.1	9.4	11.9	10.9	3.59	3.94	4.10	2.73
	April	10.5	9.9	9.4	12.3	10.8	3.60	3.97	4.10	2.68
	May	10.3	9.7	9.9	11.5	10.7	3.64	4.09	4.10	2.53
	June	10.1	9.7	9.9	11.0	10.3	3.64	4.09	4.10	2.53
	July	10.7	10.1	9.9	10.6	10.2	3.64	4.09	4.10	2.53
	August	11.1	10.5	10.1	10.5	9.7	3.64	4.09	4.10	2.53
	September	11.8	11.3	11.5	10.5	10.4	3.64	4.09	4.10	2.53
	October	12.0	11.8	11.7	10.5	10.5	3.64	4.09	4.10	2.53
	November	11.9	10.3	11.7	10.1	10.9	3.64	4.09	4.10	2.53
	December	11.7	10.5	11.7	10.3	11.3	3.64	4.09	4.10	2.55
1898.	January	11.7	10.5	11.7	11.3	11.5	3.64	4.09	4.10	2.53
	February	11.6	10.4	11.6	10.3	12.4	3.64	4.09	4.10	2.48
	March	10.0	10.2	11.4	11.1	12.1	3.64	4.09	4.10	2.36
	April	10.8	10.5	11.5	11.9	11.4	3.64	4.09	4.10	2.36
	May	10.9	10.6	11.7	17.1	11.5	3.64	4.09	4.10	2.50
	June	11.1	10.8	11.7	11.5	12.1	3.64	4.09	4.10	2.56
	July	10.8	10.3	11.7	9.9	12.1	3.64	4.09	4.10	3.13
	August	10.8	10.5	11.7	9.2	12.3	3.64	4.09	4.10	3.13
	September	10.8	10.5	11.7	9.1	12.6	3.64	4.09	4.10	3.13
	October	10.8	10.5	11.7	9.6	12.3	3.64	4.09	4.10	3.13
	November	10.8	10.5	11.7	9.9	12.6	3.64	4.11	4.09	3.13
	December	10.7	10.5	11.7	10.4	12.7	3.64	4.11	4.09	3.13
1899.	January	10.8	10.5	11.7	10.2	13.1	3.64	4.11	4.09	3.13
	February	10.8	10.5	11.7	10.5	12.9	3.58	3.98	4.06	3.13
	March	10.8	10.5	11.7	10.6	13.1	3.52	3.85	4.03	3.13
	April	11.0	10.7	11.1	10.7	13.6	3.56	3.90	4.06	3.13
	May	11.1	10.7	10.8	10.6	14.6	3.58	3.91	4.07	3.13
	June	12.0	11.4	11.1	10.3	15.3	3.58	3.91	4.07	3.13
	July	11.8	11.4	11.1	10.4	15.2	3.58	3.91	4.07	3.13
	August	11.7	11.4	11.1	10.4	15.1	3.58	3.91	4.07	3.13
	September	11.4	11.4	11.1	10.5	14.8	3.58	3.91	4.07	3.13
	October	11.1	11.1	10.9	10.9	14.3	3.58	3.91	4.07	3.60

FOURTH

REPORT ON FOOD PRODUCTS.

To His Excellency, GEORGE E. LOUNSBURY, *Governor of Connecticut:*

As required by law, I herewith submit the fourth annual Report of the Connecticut Agricultural Experiment Station on Food Products, for the year 1899.

Very respectfully,

S. W. JOHNSON, *Director.*

THE CONNECTICUT FOOD LAW.

CHAPTER CCXXXV.

PUBLIC ACTS, JANUARY SESSION, 1895, ENTITLED

An Act regulating the Manufacture and Sale of Food Products, amended by Chapter XXII, Public Acts, January Session, 1897, entitled An Act amending an Act Regulating the Manufacture and Sale of Food Products.

(The amended Sections are in italics.)

Be it enacted by the Senate and House of Representatives in General Assembly convened:

SECTION 1. It shall be unlawful for any person, persons, or corporation within this State to manufacture for sale, offer or expose for sale, have in his or their possession for sale, or to sell, any article of food which is adulterated or misbranded within the meaning of this act.

SEC. 2. The term food, as used in this act, shall include every article used for food or drink by man, horses, or cattle. The term misbranded, as used in this act, shall include every article of food and every article which enters into the composition of food, the package or label of which shall bear any statement purporting to name any ingredient or substance as not being contained in such article, which statement shall be untrue in any particular; or any statement

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purporting to name the substance or substances of which such article is made, which statement shall not give fully the names of all substances contained in such article in any measurable quantity.

SEC. 3. For the purposes of this act, an article shall be deemed adulterated:

First, if any substance or substances be mixed or packed with it so as to reduce or lower or injuriously affect its quality or strength;

Second, if any inferior substance or substances be substituted wholly or in part for the article;

Third, if any valuable constituent of the article has been wholly or in part abstracted;

Fourth, if it be an imitation of or sold under the name of another article;

Fifth, if it is colored, coated, polished, or powdered whereby damage is concealed, or if it is made to appear better or of greater value than it is;

Sixth, if it contains poisonous ingredients which may render such article injurious to the health of a party consuming it, or if it contain any antiseptic or preservative not evident and not known to the purchaser or consumer;

Seventh, if it consists, in whole or in part, of a diseased, filthy, decomposed, or putrid substance, either animal or vegetable, unfit for food, whether manufactured or not, or if it is in any part the product of a diseased animal, or of any animal that has died otherwise than by slaughter;

Provided, that an article of food product shall not be deemed adulterated or misbranded within the meaning of this act in the following cases.

(*a*) In the case of mixtures or compounds which may be now or from time to time hereafter known as articles of food under their own distinctive names, and not included in definition fourth of this section;

(*b*) In the case of articles labeled, branded, or tagged, so as plainly or correctly to show that they are mixtures, compounds, combinations, or blends;

(*c*) When any matter or ingredient is added to a food because the same is required for the protection or preparation thereof as an article of commerce in a fit state for carriage or consumption and not fraudulently to increase the bulk, weight, or measure of the food, or to conceal the inferior quality thereof;

(*d*) When a food is unavoidably mixed with some extraneous matter in the process of collection or preparation.

SEC. 4. *The Connecticut Agricultural Experiment Station shall make analyses of food products on sale in Connecticut, or kept in Connecticut for export, to be sold without the State, suspected of being adulterated. Samples of food products for analysis shall be taken by the duly authorized agents of the Station, or by the Dairy Commissioner or his Deputy, at such times and places and to such an extent as in*

the judgment of the officers of said Experiment Station and of the Dairy Commissioner shall seem expedient. The Dairy Commissioner or his Deputy shall have full access at all reasonable hours to any place wherein it is suspected that there is kept for sale or for export, as above specified, any article of food adulterated with any deleterious or foreign ingredient or ingredients, and said Dairy Commissioner or his Deputy, upon tendering the market price of such article, may take from any person, firm, or corporation samples of the same. The said Experiment Station may adopt or fix standards of purity, quality, or strength, when such standards are not specified by law.

SEC. 5. *Whenever said Experiment Station shall find by its analysis that adulterated food products have been on sale in the State, or kept in the State for export, for sale without the State, it shall forthwith transmit the facts so found to the Dairy Commissioner, who shall make complaint to the proper prosecuting officer, to the end that violators of the law relating to the adulteration of food products shall be prosecuted.*

SEC. 6. The said Station shall make an annual report to the governor upon adulterated food products, in addition to the reports required by law, which shall not exceed one hundred and fifty pages, and said report may be included in the report which said Station is already authorized by law to make, and such annual reports shall be submitted to the general assembly at its regular session.

SEC. 7. To carry out the provisions of this act, the additional sum of twenty-five hundred dollars is hereby annually appropriated to said Connecticut Agricultural Experiment Station, which sum shall be paid in equal quarterly installments to the treasurer of the board of control of said Station, upon the order of the comptroller, who is hereby directed to draw his order for the same.

SEC. 8. Any person who, either by himself, his agent, or attorney, with the intent that the same may be sold as unadulterated, adulterates any food products for man, or horses, or cattle, or, knowing that the same has been adulterated, offers for sale or sells the same as unadulterated, or without disclosing or informing the purchaser that the same has been adulterated, shall be fined not more than five hundred dollars, or imprisoned not more than one year.

SEC. 9. No action shall be maintained in any court in this State on account of any sale or other contract made in violation of this act.

SEC. 10. All acts and parts of acts inconsistent herewith are hereby repealed.

Approved, June 26, 1895.

The General Assembly in 1899 also passed an act regulating the Sale of Concentrated Commercial Feeding Stuffs, which, as regards these materials, places on the Station further duties than those imposed by the Pure Food Law just cited. The text of this Act is as follows:

THE CONNECTICUT LAW REGARDING COMMERCIAL FEEDING STUFFS.

CHAPTER CCXIX.

PUBLIC ACTS, JANUARY SESSION, 1899.

An Act concerning the Regulation of the Sale of Concentrated Commercial Feeding Stuffs.

Be it enacted by the Senate and House of Representatives in General Assembly convened:

SECTION 1. Every lot or parcel of concentrated commercial feeding stuff, as defined in section three of this act, used for feeding domestic animals, sold, offered, or exposed for sale within this State, shall have affixed thereto in a conspicuous place on the outside thereof, a legible and plainly printed statement, clearly and truly certifying the number of net pounds of feeding stuff contained therein, the name, brand, or trademark under which the article is sold, the name and address of the manufacturer or importer, and a statement of the percentage it contains of crude fat and of crude protein, allowing one per cent. of nitrogen to equal six and one-fourth per cent. of protein, both constituents to be determined by the methods adopted at the time by the Association of Official Agricultural Chemists of the United States.

SEC. 2. The term concentrated commercial feeding stuff as herein used shall not include hays and straws, the whole seeds nor the unmixed meals made directly from the seed of wheat, rye, barley, oats, Indian corn, buckwheat, or broom corn.

SEC. 3. The term concentrated commercial feeding stuff as herein used shall include linseed meals, cotton seed meals, pea meals, cocoanut meals, gluten meals, gluten feeds, maize feeds, starch feeds, sugar feeds, dried brewers grains, malt sprouts, hominy feeds, cerealine feeds, rice meals, oat feeds, corn and oat chop, corn and oat feeds, ground beef, or fish scraps, mixed feeds, provenders, bran, middlings, and mixed feeds made wholly or in part from wheat, rye, or buckwheat, and all materials of a similar nature not included in section two of this act.

SEC. 4. Each and every manufacturer, importer, agent, or seller of any concentrated commercial feeding stuff shall, upon request, file with the Connecticut Agricultural Experiment Station a certified copy of the statement named in section one of this act.

SEC. 5. Each and every manufacturer, importer, agent, or person selling, offering, or exposing for sale in this State any concentrated commercial feeding stuff, as defined in section three of this act, without the statement required by section one of this act, and stating that said feeding stuff contains substantially a larger percentage of either of the constituents mentioned in section one than is contained therein, or in relation to which the provisions of all of the foregoing sections

have not been fully complied with, shall be fined not exceeding one hundred dollars for the first offense and not exceeding two hundred dollars for each subsequent offense.

SEC. 6. The Connecticut Agricultural Experiment Station is hereby authorized to have collected a sample not exceeding two pounds in weight, for analysis from any lot, parcel, or package of concentrated commercial feeding stuff as defined by section three of this act, or unmixed meals, brans, or middlings named in section two of this act, which may be in the possession of any manufacturer, importer, agent, or dealer, but said sample shall be taken in the presence of said party or parties in interest or their representatives, and taken from a number of parcels or packages which shall be not less than five per cent. of the whole lot inspected, and shall be thoroughly mixed, divided into two samples, placed in glass vessels, carefully sealed, and a label placed on each stating the name or brand of the feeding stuff or material sampled, the name of the party from whose stock the sample was taken, and the time and place of taking the same, and said label shall be signed by said chemist or his deputy, and by the party or parties in interest or their representatives present at the taking and sealing of said sample; one of said samples shall be retained by said chemist or his deputy and the other by the party whose stock is sampled. Said Connecticut Agricultural Experiment Station shall cause at least one sample of each brand of feeding stuff collected as herein provided to be analyzed annually by or under the direction of said chemist. Said analysis shall include determinations of crude fat and crude protein and such other determinations as may at any time be deemed advisable. Said Connecticut Agricultural Experiment Station shall cause the analysis so made to be published in station bulletins, together with such other additional information in relation to the character, composition, and use thereof as may seem to be of importance, and issue the same annually, or more frequently, if deemed advisable.

SEC. 7. It shall be the duty of the Dairy Commissioner to attend to the enforcement of this act, and when any evidence is submitted by the Connecticut Agricultural Experiment Station that the provisions of this act have been violated, he shall make complaint to the proper prosecuting officer, to the end that the violator may be prosecuted.

SEC. 8. The term importer for all the purposes of this act is intended to apply to such person or persons as shall bring into or offer for sale within this State, concentrated commercial feeding stuffs manufactured without this State.

SEC. 9. This bill shall not apply to feed ground from whole grain and sold directly from manufacturer to consumer.

SEC. 10. All acts or parts of acts inconsistent herewith are hereby repealed.

SEC. 11. This act shall take effect on and after July first, 1899.

Approved, June 20, 1899.

DUTIES OF THE STATION UNDER THE FOOD LAW AND THE LAW REGULATING THE SALE OF COMMERCIAL FEEDING STUFFS.

The fourth, fifth, and sixth sections of the Food Law lay certain duties upon this Station as follows:

1st. To make analyses of food products suspected of being adulterated.

2d. Whenever it shall find by its analyses that adulterated food products have been on sale, it shall forthwith transmit the facts so found to the Dairy Commissioner.

3d. The Station shall make an annual report.

The law also provides that the Station may adopt or fix standards of purity, quality, or strength, when such standards are not specified or fixed by statute.

The sixth section of the law, regulating the Sale of Commercial Feeding Stuffs, requires the Station,

1st. To determine crude fat and crude protein annually in at least one sample of each brand of feeding stuff which it may have collected.

2d. To publish these analyses in Station Bulletins, at least annually, with such additional information as to the character, composition and use of commercial feeds as may seem to be of importance.

The Station is also authorized to collect samples of commercial feeding stuffs for analysis from any manufacturers, importers, agents or dealers, and they are required to give the Station, if requested by it, a certified copy of the statement described in section one of the law.

SAMPLES EXAMINED BY THE STATION.

During the year beginning Aug 1, 1898, authorized agents of the Station have visited twenty-one towns and villages of this State and purchased samples of food products for examination at this Station.

These places were distributed as follows:

	No. of Places.
Litchfield Co.	0
Hartford Co.	2
Windham Co.	2
Tolland Co.	0
New London Co.	3
Middlesex Co.	2
New Haven Co.	7
Fairfield Co.	5
	21

In all there have been bought by the Station three hundred and forty-three samples, of the following names or kinds:

	No. of Samples.
Coffee	88
Coffee substitutes	2
Soda water syrups	92
Bottled syrup	23
Fruit juices	5
Bottled carbonated drinks	90
Peanut butter	2
Food Preservatives	31
Borax	7
Banana flour	3
Total	343

The State Dairy Commissioner is now charged by statute with the enforcement of laws regulating the sale of butter, vinegar, molasses and concentrated commercial feeds.

From the time when the office of Dairy Commissioner was established, 1886, this Station has done at its own cost all the chemical work desired by the Commissioner and has given needful expert evidence in court.

Under the amendment to the Food Law, passed at the session of the General Assembly in 1899, the Commissioner is also empowered to collect samples of food products, the Station is required to report to him all cases of adulteration, and he is required to make complaint to the prosecuting officer.

During the twelve months ending August 1st, 1899, the Station has received from the Commissioner and examined 323 samples, as follows:

	No. of Samples.
Butter and imitation butter	2
Molasses and syrup	213
Vinegar	45
Honey	2
Coffee	61
	323

Three samples of vinegar and forty-three samples of milk and cream, not collected by the Station agent or Dairy Commissioner, have been examined.

In studying the chemical composition and microscopical structure of spices, twenty-five samples of genuine spices, taken from imported packages, and two samples of spice adulterants have also been analyzed, making the total number of examinations seven hundred and thirty-nine.

THE CHEMICAL COMPOSITION OF AUTHENTIC SAMPLES OF SPICES AND SPICE ADULTERANTS.

By A. L. Winton, A. W. Ogden and W. L. Mitchell.

In the report of this Station for 1898 are given analyses of one hundred and one samples of whole spices drawn by a representative of the Station from the original packages of importers at New York and Boston; also, of twenty-four samples of spice adulterants. These analyses were made to secure data for fixing standards of composition of the spices used in the United States, and to learn how their composition is affected by the addition of adulterants.

During the present year, twenty-five additional samples of whole spices, representing for the most part grades which were not analyzed in 1898, and two samples of adulterants, have been secured through the courtesy of Messrs. Bennett, Simpson & Co., London and New York.

Analyses of these samples, made by the methods described in the report for 1898, will be found in Table I, pp. 102 to 103.

Description of Samples.

9805. *Mangalore black pepper.* The corns are unusually large for black pepper. Their exterior is deep black, the interior yellow green in color. The powder is greenish black. This pepper is not likely to be found in our market.

9819. *Singapore shot pepper.* In the preparation of this pepper, which is not used for grinding, the corns are washed, dried and oiled. By these operations the appearance is improved, at the expense of quality.

9806. *Malabar black pepper.* This pepper is said to be grown in groves of mango and bread-fruit trees. The berries are hand picked and sun dried.

9807. *Coriander or Alleppy white pepper.* This variety is prepared in imitation of coriander, by paring off from the end of each corn a piece of the outer hull, thus exposing an inner layer of darker color.

9818. *Tellicherry white pepper.* Is one of the best grades in our market. The corns are of large size and of a uniform light color.

9826. *Paprika or Hungarian pepper.* The dried pods are from seven to ten cm. long and (flattened) from three to seven cm. wide.* The surface is shiny and of a dark red color. When held to the light the color is a fine claret red. The stems, which have not been detached, are from three to five cm. long and constitute seven per cent. by weight of the sample. This pepper is milder than the closely related varieties of cayenne pepper and has a sweet taste.

9820. *Chili Colorado.* A mild pepper grown in Mexico. The pods in the sample are of a dull brick color, and from seven to ten cm. long and (flattened) from two to four cm. wide.* The stems and calyxes are absent.

9861. *Natal or Durban cayenne pepper.* The dark red pods (from one to two cm. broad and five to ten cm. long*) are free from stems and calyxes.

9809. *Nepaul cayenne pepper.* A pepper grown in Hindostan, with pods three to six cm. long and one to one and a half cm. wide,* of brown yellow color.

*The centimeter (cm.) is approximately $^4/_{10}$ inch and the millimeter (mm.) $^4/_{100}$ inch.

TABLE I.—ANALYSES OF PURE WHOLE

Station No.		Weight of 1 litre in grams.	Weight of 100 single kernels or specimens in grams.	Moisture.	Ash.		
					Total.	Soluble in water.	Insoluble in HCl.
	Black Pepper:						
9805	Mangalore	574.	8.57	11.61	4.23	2.19	0.19
9819	Singapore Shot	530.	5.25	11.50	3.70	1.42	0.20
9806	Malabar	570.	5.74	9.47	3.45	2.26	0.09
	White Pepper:						
9807	Coriander or Alleppy	588.	4.21	9.47	1.05	0.25	0.04
9818	Tellicherry	650.	6.67	11.13	0.97	0.22	0.00
	Paprica:						
9826	Hungarian	------	621.	8.77	6.45	5.05	0.11
	Cayenne Pepper:						
9820	Chili Colorado	------	180.	15.96	6.19	5.13	0.04
9861	Natal	------	112.	13.58	5.51	4.57	0.07
9809	Nepaul	------	50.8	5.71	6.07	4.54	0.05
9810	Zanzibar	------	4.45	5.18	6.13	4.29	0.15
	Ginger:						
9812	Bleached Jamaica (limed)	------	------	9.72	5.28	2.60	0 24
9811	Washed Jamaica	------	------	10.11	3.18	2.24	0.15
9813	Bleached Cochin (limed)	------	------	9.14	4.99	3.52	0.09
	Cinnamon:						
9815	Ceylon, extra fine	------	------	6.54	5.23	1.62	0.07
	Cassia:						
9823	Penang	------	------	7.04	4.53	2.03	0.08
9822	Travencore	------	------	8.06	5.72	1.81	0.00
9821	Malabar	------	------	8.57	4.80	1.79	0.03
	Cloves:						
9825	Penang	------	10.78	7.91	5.44	3.30	0.04
9824	Bencoolen	------	9.88	6.73	6.00	3.80	0.03
	Nutmeg:						
9814	Brown Penang, 54's	------	944.	7.69	1.85	0.85	0.04
9831	Brown Penang, 80's	------	572.	9.40	1.88	0.76	0.00
	Mace:						
9808	Hand Picked	------	------	10.71	1.56	0.87	0.02
9829	Penang	------	------	9.41	1.67	0.92	0.03
9828	Banda	------	------	7.82	1.74	1.00	0.00
9827	Batavia	------	------	8.89	2.49	1.26	0.21
	Adulterants:						
9816	Exhausted Cubebs	------	------	5.60	10.38	6.32	0.77
9817	Exhausted Allspice	------	------	7.69	4.50	2.59	0.00

Spices and Spice Adulterants.

Lime. (CaO.)	Ether extract. Volatile.	Ether extract. Non-volatile.	Alcohol extract.	Reducing matters by direct inversion calculated as starch.	Starch by diastase method.	Crude fiber.	Total N. less N. in non-volatile ether extract, x 6¼.	Nitrogen. Total.	Nitrogen. In non-volatile ether extract.	Parts of N. in 100 parts non-volatile ether extract.	Cold water extract.
------	1.50	9.08	9.97	------	34.93	10.00	11.87	2.24	0.35	3.46	------
------	1.44	7 49	8.54	------	33.19	10.58	12.06	2.21	0.25	3.29	------
------	1.04	6.10	6.94	------	44.83	9.68	12.56	2.26	0.24	3.86	------
------	0.55	7.28	8.05	------	57.60	4.54	12.44	2.31	0.31	4.25	------
------	0.64	6.68	7.55	------	60.41	3.94	12.12	2.24	0.28	4.18	------
------	1.12	7.74	21.24	------	3.93	22.59	14.56	2.33	------	------	------
------	0.36	15.45	30.42	------	1.38	13.93	11.94	1.91	------	------	------
------	0.85	16.00	24.95	------	------	19.12	16.81	2.69	------	------	------
------	0.85	20.46	23.78	------	1.46	24.25	14.87	2.38	------	------	------
------	0.56	15.63	19.92	------	1.46	27.65	14.62	2.34	------	------	------
1.33	1.25	2.47	3.31	------	61.76	2.72	9.19	1.47	------	------	14.57
0.13	0.97	2.58	2.61	------	56.31	2.43	11.12	1.78	------	------	15.85
1.61	1.60	3.61	3.53	------	64.18	3.42	6.06	.97	------	------	7.72
------	1.94	1.73	16.73	22.86	------	33.26	4 56	.73	------	------	------
------	5.84	3.07	6.07	23.76	------	20.09	4.75	.76	------	------	------
------	4.18	1.14	12.02	22.05	------	20.69	4.25	.68	------	------	------
------	3.25	1.30	11.97	23.22	------	22.27	4.50	.72	------	------	------
------	19.71	5.12	15 92	------	2.25	8.74	6.31	1.01	------	------	------
------	20.09	5.14	15.23	------	2.62	9.60	6.12	.98	------	------	------
------	5.03	31.26	10.49	------	30.09	2.40	6.19	.99	------	------	------
------	2.64	34.80	11.71	------	26.16	2.70	7.12	1.14	------	------	------
------	5.79	23.30	24.72	------	24.19	2.57	5.87	.94	------	------	------
------	8.65	21.23	26.04	------	31.61	3.22	6.06	.97	------	------	------
------	10.80	23.82	27.02	------	27.17	3.10	6.81	1.09	------	------	------
------	13.03	22.00	27.07	------	22.68	4 01	7.87	1.26	------	------	------
------	1.32	8.58	10.82	------	8.55	27.64	11.25	1.80	------	------	------
------	0.42	6.07	8.64	------	7.42	22.89	6.44	1.03	------	------	------

9810. *Zanzibar cayenne pepper.* This sample is of fine quality, containing neither stems nor calyxes. The pods (0.5 to 1 cm. long and from 0.3 to 0.5 cm. wide*) are brick red in color.

9812. *Bleached or limed Jamaica ginger.*

9811. *Washed Jamaica ginger.*

9813. *Bleached or limed Cochin ginger.*

The three samples of ginger are made up of large and selected roots.

9815. *Ceylon cinnamon, extra fine.* The composite quills are but four to five mm.* in diameter.

9823. *Penang cassia.* One of the best of the cassias. Bark from one-half to two mm.* thick.

9822. *Travencore cassia.* The bark, which has been scraped, is of a light brown color and varies in thickness from two to four mm.* Like Batavia cassia, the ground bark forms a glutinous mass when stirred up with water.

9821. *Malabar cassia* closely resembles Batavia cassia. The bark is from one-half to three mm.* in thickness.

9825. *Penang cloves.*

9824. *Bencoolen cloves.* A variety which is said to be often sold for Penang.

9814. *Brown Penang nutmegs, fifty-four to the pound.* Kernels two and eight-tenths to three and a half cm. long and two to three cm.* wide.

9831. *Brown Penang nutmegs, eighty to the pound.*

Like 9814, but of smaller size.

9808. *Hand picked mace.* Large perfect blades selected by hand.

9829. *Penang mace.*

9828. *Banda mace.*

9827. *Batavia mace.*

9816. *Exhausted cubebs.* Sold for two cents per pound, as an adulterant for black pepper.

9817. *Exhausted allspice.* Sold for four cents per pound for use as an adulterant.

*The centimeter (cm.) is approximately $^{4}/_{10}$ inch and the millimeter (mm.) $^{4}/_{100}$ inch.

Notes on the Analyses.

Black and white pepper. In the report for 1898 the conclusion was reached that determinations of non-volatile ether-extract and of the nitrogen therein, furnish the best means of detecting adulterants of vegetable origin. This conclusion is confirmed by the results reported herewith.

In the sample of Malabar pepper, No. 9806, the percentages of non-volatile ether-extract, and of alcohol extract are unusually low.

Paprika. This pepper contains a much lower percentage of non-volatile ether-extract than other varieties of capsicum which have been examined. It also has a sweeter taste and, therefore, presumably, a higher percentage of sugar. Because of these differences, paprika should be classed apart from cayenne pepper.

Cayenne pepper. The varieties examined, although widely different in appearance, have essentially the same composition.

Ginger. The cold-water extract in No. 9813 is abnormally low, indicating perhaps that the sample has been soaked in water.

Cassia. The sample of Penang cassia has about the same composition as the samples of Saigon cassia examined last year. Travencore, Malabar and Batavia cassia are not only much alike in physical properties, but also in composition.

Cloves. One of the most valuable means of detecting adulteration in cloves is the determination of volatile ether-extract. The minimum percentage of this extract obtained in the analyses of genuine samples, during the past two years, is 17.82.

Nutmeg. The two samples of brown Penang nutmeg have practically the same composition as the limed Singapore nutmegs examined in 1898.

Mace. The percentages of ash, non-volatile ether-extract, alcohol extract and "starch" do not vary greatly in the varieties of true mace, and determinations of these ingredients are of great value in detecting Bombay mace and other adulterants.

COFFEE.

By A. L. Winton.

When the food law went into operation (1896), the cheaper grades of coffee, both ground and unground, which were sold in Connecticut were extensively adulterated.

Of forty-nine samples, bought in that year by Station agents for twenty-five cents or less per pound, not one was pure coffee.

During the past four years there has been a marked decrease in the number of adulterated "coffees" sold in this State, as appears in the following statement.

Table II.—Percentage of Samples of Coffee found Adulterated.

Year.	Number Examined.	Percentage number adulterated. Whole Coffee.	Ground Coffee.	Both Whole and Ground.
1896	109	25.0	89.2	63.3
1897	71	7.1	86.6	57.7
1898	40	8.7	40.9	24.4
1899	149	1.5	18.8	10.3

This decrease in the percentage of adulterated samples cannot be attributed to change from year to year in the place or price of purchase.

The agents have each year sought to buy the cheaper grades of coffee in a considerable number of cities and towns.

The average prices paid in these years for the samples have been as follows:

Table III.—Average Prices of Coffee bought by Station Agents.

Year.	Ground Coffee, Pure. No. Samples.	Average price per pound.	Ground Coffee, Adulterated. No. Samples.	Average price per pound.
1896	7	37.0	58	24.5
1897	6	26.0	41	25.0
1898	13	26.8	11	24.5
1899	66	26.7	14	22.4

The marked decrease in the sales of adulterated coffee in this State, thus indicated, is no doubt largely due to the work of this Station.

During the last twelve months one hundred and forty-nine samples have been examined, classified as follows:

	Unground.	Ground.	Total.
Number of samples not found adulterated....	68	66	134
Number of samples found adulterated.....	1	14	15
Total	69	80	149

Particulars regarding these samples are given in Tables IV and V, pages 108 to 111.

All labels other than the retailer's name and address that were found on packages of coffee are copied in the Table.

Samples put up in paper bags without labels are specified as "sold in bulk."

Of the whole number of coffee samples collected, sixty-one were bought by the Dairy Commissioner and eighty-eight by the Station.

Coffee Compounds and Substitutes. Two samples have been examined as follows:

No. 11471. "Combination Coffee." Bought of Russell Bros., State and Court sts., New Haven, 20 cents per pound. Contained coffee, chicory and imitation coffee made from wheat middlings.

No. 11434. "Hayward & Co., French Breakfast Coffee Compound, manufactured by Dwinell, Wright & Co., Boston." The word "Compound" was inconspicuous. Bought of Daniel Sullivan, Putnam, 10 cents per pound package. Consisted chiefly of ground peas and cereals. No real coffee was found.

TABLE IV.—COFFEE NOT FOUND ADULTERATED.

Station No.	BRAND.	DEALER.	Price per pound, cts.
	Unground Coffee.		
11460	Sold in bulk	*Ansonia.* W. H. Bronson, 234 Main St.	38
11455	" " "	P. W. Fogarty, 11 High St.	30
11454	" " "	Geo. E. May & Son, Maple and High Sts.	35
11457	" " "	Geo. McCabe, 19 High St.	35
11452	" " "	New York Grocery Co., 134 Main St.	17
11451	" " "	New York Grocery Co., 134 Main St.	27
11458	" " "	J. D. Welch & Co., Main St.	20
11459	" " "	J. D. Welch & Co., Main St.	25
9967	Thos. Wood & Co., Boston	*Bridgeport.* Osborne Bros., Noble Ave. & Jane St.	25
9995	Magnolia Blended. Bennett, Sloan & Co., New York	*Danbury.* McGraw & Baldwin, 91 White St.	32
11128	Sold in bulk	Union Pacific Tea Co., 253 Main St.	16
11461	Manila Coffee	*Derby.* G. W. Coggswell, 30 Elizabeth St.	25
11125	Sold in bulk	Kamak's Bargain House, 181 Main St.	25
11465	" " "	James McEnerney	38
11462	" " "	New York Grocery Co., Main St.	25
11051	" " "	*Groton.* C. S. Avery, 95 Thames St.	25
11037	" " "	*Hartford.* J. C. & Co., 558 Asylum St.	20
11038	" " "	R. S. Kennedy, 1040–46 Main St.	20
11090	" " "	*Middletown.* American Tea Co., 490 Main St.	20
11088	" " "	S. T. Camp, 234 Main St.	25
11087	" " "	Winterich & Kirby, 218 Main St.	25
11089	" " "	*Portland.* C. H. Bell, Main St.	20
11099	" " "	*New Britain.* Home Tea Co., 460 Main St.	20
11166	" " "	*New Haven.* S. S. Adams, 745 Grand Ave.	28
11170	" " "	Chas. Baum, 295 Oak St.	20
11146	" " "	Cedar Hill Exchange, 1132 State St.	25
11167	" " "	G. M. Clark, 358 Congress Ave.	20
11469	" " "	Conn. Tea Co., Grand Ave. & Franklin St.	25
11473	" " "	Geo. W. Cooper, Grand Ave. & Artizan St.	20
11164	" " "	C. F. Curtiss, 954 State St.	25
11466	" " "	Daniel Dore, 579 Grand Ave.	30
9592	Diamond B. Wm. Boardman & Sons Co., Hartford	Gibbons Bros., State & Pearl Sts.	30
11470	Sold in bulk	Johnson & Bro., 411 State St.	25
11475	" " "	Harry Leigh Co., 354–6 State St.	35
11160	" " "	F. J. Markle, Olive & State Sts.	24
11467	" " "	Hermon Mosca, 177 Hamilton St.	15
11474	" " "	E. E. Nichols, 378 State St.	25
11472	" " "	Russell Bros., State & Court Sts.	30
11169	" " "	J. L. Stevens, 255 Congress Ave.	28
11165	" " "	W. E. Waterbury, 774 State St.	20
11468	" " "	R. Zeidler, 768 Grand Ave.	30
11047	" " "	*New London.* Daboll & Freeman, 148 State St.	22
11412	" " "	D. Donovan, 135 Main St.	36
11401	" " "	Daboll & Freeman, 148 State St.	22
11409	" " "	D. Donovan, 135 Main St.	36
11410	" " "	D. Donovan, 135 Main St.	20
11411	" " "	D. Donovan, 135 Main St.	30
11414	" " "	A. E. Foster, 120 Main St.	36
11413	" " "	A. E. Foster, 120 Main St.	20
11408	" " "	M. Joseph, 145 Main St.	30
11406	" " "	J. N. Miner, Main St.	36
11405	" " "	Mohican Grocery Co., State St.	14
11048	" " "	John Rollo, 66 Main St.	25

TABLE IV.—COFFEE NOT FOUND ADULTERATED—*Continued.*

Station No.	BRAND.	DEALER.	Price per pound, cts.
	Unground Coffee—Continued.		
9947	Eureka Blend. Ross W. Weir & Co., N. Y.	*Norwalk.* W. & E. Osterbank, 53 Main St.	25
11060	Sold in bulk	*Norwich.* Hong Kong Tea Co., 210 Main St.	25
11066	" " "	E. W. Phillips, 47 Shetucket St.	16
11069	" " "	W. A. Smith, 135 Main St.	22
11117	" " "	*Waterbury.* Brooklyn Co-operative Store, 875 Bank St.	25
11116	" " "	A. W. Brumaghim, 844 Bank St.	25
9994	White House Mocha & Java. Dwinell Wright & Co., Boston	J. A. Edmundson, 415 So. Main St.	35
11416	Sold in bulk	*Willimantic.* S. E. Amidon, 877 Main St.	12
11417	" " "	S. E. Amidon, 877 Main St.	36
11074	" " "	F. P. Casey, 81 Jackson St.	25
11423	" " "	C. R. Hibberd, 22 North St.	30
11071	" " "	Frank Larrabee, Church St.	18
11424	" " "	Purrington & Reade, Main St.	36
11421	" " "	Burt Thompson, 798 Main St.	38
11420	Lion Coffee. Woolson Spice Co., Toledo, Ohio	Burt Thompson, 798 Main St.	30
	Ground Coffee.		
11453	Sold in bulk	*Ansonia.* Geo. E. May & Son, Maple & High Sts.	25
11015	" " "	*Bridgeport.* Belknap Tea Co., 511 Main St.	25
11016	" " "	Columbia Tea Co., 534 Main St.	25
11019	" " "	R. T. Whiting, 345 Main St.	25
11464	" " "	*Derby.* S. Z. D. Durand, 193 Main St.	35
11126	" " "	New York Cash Store, Main St.	20
11052	" " "	*Groton.* C. W. Allyn, Thames St.	25
11036	" " "	*Hartford.* Wm. Eustace, 119 Pearl St.	25
11035	" " "	H. E. Hills & Son, 1143 Main St.	25
9974	Olympia. The Edmunds Coffee Mills, Boston	Peckham Bros., 8 Ford St.	35
9972	Royal Arms. International Coffee Co., N. Y. & London	Union Grocery, 1026 Main St.	38
11025	Sold in bulk	*Meriden.* Boston Grocery, 17 Colony St.	28
11029	" " "	Grant's Tea Store, State & Main Sts.	16
11028	" " "	E. J. Stoddard, 300 E. Main St.	18
9987	Gold Brand Java. Brownell & Field Co., Providence	*Middletown.* G. E. Burr, 136 Main St.	25
11102	Sold in bulk	*New Britain.* A. B. Goodrich, 7 Franklin Square	20
11103	" " "	H. Oldershain, 236 Park St.	25
11476	" " "	*New Haven.* S. S. Adams, State & Court Sts.	20
11162	" " "	Conn. Tea Store, 722 Grand Ave.	20
9977	Victor. Shapleigh Coffee Co., Boston	Mrs. Gerner, State & Clark Sts.	25
11171	Crescent Mills. John P. Augur, New Haven	P. J. Lyons, 419 Congress Ave.	30
11161	Sold in bulk	F. A. Peck, 719 State St.	25
9996	H. M. Tower, New Haven	H. M. Tower, 379 Congress Ave.	25
11163	Hermitage. Stoddard, Gilbert & Co., New Haven	William & Franklin	30
11402	Royal Arms. International Coffee Co., New York	*New London.* Frank Caracausa, State St.	30
11403	Royal Arms. International Coffee Co.	Frank Caracausa, State St.	30

TABLE IV.—COFFEE NOT FOUND ADULTERATED—*Concluded.*

Station No.	BRAND.	DEALER.	Price per pound, cts.
	Ground Coffee—Continued.		
9599	Back Bay. G. P. Champlin, Boston	*New London—Continued.* M. Wilson Dart, Bank & Howard Sts	25
11415	Sold in bulk	Wm. A. Holt, 50 Main St,	26
11049	" " "	Keefe & Davis, 125 Bank St.	25
9600	Star Java. Brownell & Field Co., Providence, R. I.	W. M. Lucy, 191 Bank St.	35
11407	Sold in bulk	J. N. Miner, Main St.	36
11404	" " "	Mohican Grocery Co., State St.	14
11050	" " "	S. Prottas, 45 Bradley St.	18
9978	Autocrat Java. Brownell & Field Co., Providence	J. E. St. John, 265 Bank St.	25
11007	Sold in bulk	*Norwalk.* William M. Betts, 15 Main St.	25
9982	Silver Quarter. Swain, Earle & Co., Boston	*Norwich.* Appely & Jordan, 88 W, Main St.	25
11061	Sold in bulk	E. A. Fitch, 62 Broadway	20
11068	" " "	E. Robinson, 264 Main St.	25
9983	Golden Cup. C. H. Russell, Boston	Russell Bros., 110 Main St.	23
9988	Regal. The E. S. Kibbe Co., Hartford	*Portland.* P. Sullivan, Main St.	30
11435	Sold in bulk. Java and Mocha	*Putnam.* N. J. Bartlett	36
11436	" " "	N. J. Bartlett	36
11430	" " "	N. H. Mansfield & Co.	26
11431	" " "	N. H. Mansfield & Co.	30
11428	" " " . Java	Edward Mullan	36
11429	" " " . Java and Mocha blend	Edward Mullan	36
11437	" " " . Triple blend	A. C. Stetson	30
11433	" " "	James Sullivan	26
11432	" " "	James Sullivan	36
11008	" " "	*So. Norwalk.* F. D. Lawton & Co., 22 Main St.	25
11009	" " "	New York Grocery Co., Washington St.	25
9957	Princess. O'Donahue Coffee Co., New York	Chas. E. Seymour, 33 Washington St.	25
11001	Sold in bulk	*Stamford.* G. A. Ferris, 184 Main St.	20
11000	" " "	A. G. Weed, 1 Atlantic Square	25
11020	" " "	*Wallingford.* A. J. Martin, 29 Main St.	35
11021	" " "	Union Tea Company, 7 Hall Ave.	25
11418	" " "	*Willimantic.* S. E. Amidon, 877 Main St.	26
11419	" " "	Daintor & Johnstone, 931 Main St.	36
11070	" " "	Grand Union Tea Co., 725 Main St.	25
11072	" " "	E. C. Hall, 15 Union St.	25
11426	" " "	Frank Larrabee, 24 Church St.	36
11427	" " "	Frank Larrabee, 24 Church St.	18
11073	" " "	Purrington & Reade, 719 Main St.	22
11425	" " "	Purrington & Reade, 719 Main St.	20
9985	Yale. Howard W. Spurr Coffee Co., Boston	Burt Thompson, 800 Main St.	25
11422	Sold in bulk	Burt Thompson, 800 Main St.	36

Table V.—Coffee found Adulterated.

Station No.	Brand.	Dealer.	Price per pound, cents.	Adulterants.
	Unground Coffee.			
11100	Sold in bulk	*New Britain.* Boston Branch, 238–240 Main St.	13	Peas, 2 per cent.
	Ground Coffee.			
11127	Sold in bulk	*Danbury.* Danbury Cash Grocery, 157 Main St.	18	Chicory, imitation coffee.*
11124	" "	W. W. Edwards, 147 Main St.	25	Chicory.
11129	" "	New York Cash Grocery, 307 Main St.	20	Chicory, imitation coffee.*
11463	Mixed ground coffee	*Derby.* S. Z. D. Durand, 193 Main St.	20	Chicory, imitation coffee.*
9973	French Mixture Hotel Coffee, C. H. Russell, Boston	*Hartford.* C. H. Russell, 909 Main St.	15	Chicory, peas, imitation coffee.*
11032	Sold in bulk	*Meriden.* Russell Bros., W. Main & Colony Sts.	20	Chicory, imitation coffee.*
11101	" "	*New Britain.* Russell Bros., 301 Main St.	20	Chicory.
11006	" "	*Norwalk.* W. R. Bates, 49 Main St.	25	Chicory, peas.
11005	" "	P. J. Lynch Co., 19 Main St.	25	Chicory, pea hull pellets.†
11067	" "	*Norwich.* Thomas Wilson, 76 Franklin St.	25	Chicory, imitation coffee.*
11115	" "	*Waterbury.* Greater New York Tea Co., 172 E. Main St.	25	Chicory.
11112	" "	New York & China Tea Co., 181 S. Main St.	25	Chicory, imitation coffee.*
11114	" "	J. F. Phelan, 41 E. Main St.	25	Pea hull pellets,† chicory.
11113	" "	W. H. Wright, 42 E. Main St.	25	Imitation coffee,* chicory.

* Brown lumps made from wheat middlings to resemble coarsely crushed roasted coffee.
† Made of pea hulls and middlings resembling roasted coffee.

CARBONATED, NON-ALCOHOLIC BEVERAGES ("TEMPERANCE DRINKS," "SUMMER DRINKS") AND FRUIT FLAVORS.

By A. L. Winton, A. W. Ogden and W. L. Mitchell.

Water, variously flavored and charged with carbonic acid, commonly called "soda water,"* may be said to be the national summer drink of the United States. Although statistical proof is not obtainable, it is doubtless true that the consumption of the various carbonated non-alcoholic beverages (not including mineral waters) within our border is greater both *per capita* and *in toto* than in any other country.

In Connecticut nearly all of the five hundred apothecaries have soda fountains, and in some cases soda water, during the summer months, is a more important source of revenue than drugs. Soda fountains are also maintained by many confectioners and some of the department stores.

Bottled soda water, ginger ale and similar beverages are sold in large quantities for family use and for consumption in saloons, restaurants, fruit-stands and "Wheelmen's Rests."

Soda Water, Sold by the Glass.

Apparatus for Dispensing Soda Water. In stores where soda water is drawn for consumption from faucets, the "fountains," which are the metal cylinders in which it is stored, are kept in the cellar and from these, pipes lead to and through a box packed with ice at the dispensing counter. This box, which is commonly, but erroneously, known as the "fountain," also contains reservoirs for the various flavoring syrups and is usually cased in polished marble, with nickel faucets and trimmings.

The pressure of the carbonic acid gas in the cylinder forces the carbonated water through the pipes to the faucets, which are so arranged that a large or a fine stream can be drawn, the latter being used to mix and froth the drink.

Besides the flavoring and sweetening matters added in form of syrups, "Cream" is added to chocolate, coffee, vanilla and

*Also known as "Soda" and more appropriately as "Carbonated Water."

some other flavors, and frothed eggs, "acid phosphate" and various other materials are used in the preparation of special drinks.

Preparation of Carbonated Water. Formerly each fountain was charged by connecting with apparatus in which carbonic acid gas was set free by the action of sulphuric acid on marble dust or other carbonate, but now carbonic acid, either made from acid and carbonates or derived from mineral springs, is liquified by pressure and supplied in small steel cylinders.

Some retailers make their own carbonated water, but this work is usually done by local manufacturers, who deliver the fountains ready charged. The operation of charging is, however, a simple one and can be easily carried out by any one provided with the necessary apparatus. The "fountain" is nearly filled with cold water and placed on its side in a cradle. The cock at its end is connected by means of a stout rubber hose with the cylinder of liquid carbonic acid and the gas that freely escapes from the latter is allowed to enter the fountain, where its absorption by the water is aided by constant agitation. This is continued until the water is saturated at about 170 pounds pressure,* as shown by a gauge.

Soda Water Syrups. The syrups used in soda water consist of sugar syrup (12 to 15 pounds of granulated sugar in 1 gallon of water) mixed with fruit juices, or other flavoring materials, and frequently with gum arabic, soap bark, senegal, or some other substance, to produce foam. The most popular syrups are vanilla, lemon, orange, strawberry, raspberry, chocolate, coffee, ginger, sarsaparilla and pineapple, but there are many others which have a more or less extensive sale. A pamphlet issued by a well known house gives a list of 333 different syrups, which can be made from the materials they supply.

The syrups dispensed at soda fountains are made on the premises, or bought ready for use. In either case, they may be good or poor, pure or adulterated. Some retailers prepare their syrups from genuine fruits or fruit juices and other materials of the best quality, while others use artificial "fruit extracts," coal-tar dyes, chemical preservatives and other objectionable materials, and the same may be said of the manufacturers of syrups on a large scale.

*Mineral waters and root beer are charged at a lower pressure.

For the convenience of those who wish to make their own syrups, but do not care to handle the fruits, many kinds of genuine fruit juices and crushed fruits are now on the market in sealed bottles, jugs and jars. These preparations are sent out sterilized, or otherwise treated to prevent spoiling, and will generally keep until opened. For use they are mixed with sugar syrup and a little citric or tartaric acid, to bring out the flavor.

In justice to the trade it should be stated that those who have built up a flourishing business, use, as a rule, good materials and dispense beverages which are both wholesome and delicious. Syrups containing artificial flavoring and coloring matters are not acceptable to the better class of trade and are dispensed chiefly in the tenement districts, at shore resorts, etc.

All artificial flavoring substances cannot, however, be regarded as adulterants. Oil of wintergreen and vanillin (the valuable constituents of the vanilla bean) are now prepared by purely chemical means, and, although not considered quite so delicate in flavor as the genuine, still the difference is really a matter of quality rather than of purity.

But the artificial extracts made to imitate strawberry, raspberry and some other fruit juices or flavors belong in another category, as they are, in many cases, quite unlike the flavoring matters of the true fruits in chemical composition, as well as in flavor, and when taken in ice cream or soda water are apt to produce unpleasant consequences; indigestion and diarrhœa. Often within a half hour after taking them, their artificial nature becomes very evident to the senses of taste and smell.

The following recipes of J. H. Maisch, for the preparation of artificial extracts, given by Allen,* illustrate the complex nature of some of them.

"The number given indicates the number of measures of the ethers, etc., to be added to each 100 measures of rectified spirit. * * * To make the essences of orange and lemon, 10 parts of the respective essential oils must be employed in addition to the ingredients given in the Table."

*Commercial Organic Analysis. 2d Edition. Vol. I, p. 163.

	Pine-apple.	Melon.	Strawberry.	Raspberry.	Currant.	Grape.	Apple.	Pear.	Cherry.	Plum.	Apricot.	Peach.	Orange.	Lemon.	Banana.
Chloroform	1	--	--	--	--	2	1	--	--	--	1	--	2	1	--
Aldehyde	1	2	--	1	1	2	2	--	--	5	--	2	2	2	--
Methyl salicylate	--	--	1	1	--	1	--	--	--	--	--	--	1	--	--
Ethyl nitrite	--	--	1	1	--	--	1	--	--	--	--	--	--	1	--
" formate	--	1	1	1	--	2	--	--	--	1	--	5	1	--	--
" acetate	--	--	5	5	5	--	1	5	5	5	--	5	5	10	--
" butyrate	5	4	5	1	--	--	--	--	--	2	10	5	1	--	10
" valerate	--	5	--	--	--	--	--	--	--	--	5	5	--	--	--
" pelargonate	--	--	--	1	1	10	--	--	1	--	1	--	--	--	--
" benzoate	--	--	--	1	1	--	--	--	5	--	--	--	1	--	--
" sebate	--	10	--	1	--	--	--	--	--	--	--	1	--	--	--
Amyl alcohol	--	--	--	--	--	--	--	--	--	--	2	2	--	--	--
" acetate	--	--	3	1	--	--	--	2	--	--	--	--	1	--	10
" butyrate	10	--	2	1	--	--	--	--	--	--	1	--	--	--	--
" valerate	--	--	--	--	--	--	10	--	--	--	--	--	--	--	--
Tartaric acid	--	--	--	5	5	5	--	--	--	--	1	--	1	10	--
Oxalic acid	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--
Succinic acid	--	--	--	1	1	3	--	--	--	--	--	--	--	1	--
Benzoic acid	--	--	--	--	1	--	--	--	1	--	--	--	--	--	--
Glycerin	3	3	2	4	--	10	4	2	3	8	4	5	10	5	--
Benzoic aldehyde	--	--	--	--	--	--	--	--	--	4	--	5	--	--	--

The use of coal-tar dyes is also objectionable, as some of them are believed to be injurious to health.

The use of preservatives has been discussed in a preceding report.* Salicylic acid is not infrequently added to "keep" both the genuine and spurious fruit juices. The addition of this substance to food is prohibited in certain European countries because of its injurious physiological effects.

Some of the leading manufacturers of fruit juices now guarantee their goods to be entirely free from all preservatives.

Bottled Carbonated Beverages.

These, like "soda water," which is only sold by the glass, are water charged with carbonic acid and variously colored, flavored and sweetened.

Of this class of "temperance drinks," "ginger ale," put up usually in two-third pint round-bottomed bottles, is perhaps the most popular.

In addition to ginger extract and sugar it may contain a little lemon juice or citric acid and lemon oil. Sometimes capsicum is used in place of a part or all of the ginger extract.

* See also pp. 139–141 of this Report.

Other kinds of bottled effervescent beverages are "sarsaparilla"; also lemon, orange, raspberry and cream (vanilla) "soda," which differ from each other only in the flavors and coloring matters which they contain.

The above list is only a partial one, but includes those which are most in demand.

The cheap grades are commonly of local manufacture and are sold either in quart or half pint bottles, with corks or patent stoppers. The bottling of soda water is done by a machine, which adds a measured quantity of syrup and carbonated water to each bottle and inserts the stopper.

Examination of Samples from the Connecticut Market.

The samples of soda water syrups and bottled carbonated beverages represent the different grades in the market, from the cheapest to the highest priced. The bottled fruit syrups are sold for the most part by grocers for family use, but are practically the same in composition as the soda water syrups bought at soda fountains. Bottled grape juice, lime juice and some other fruit juices are often kept on soda water counters for use in carbonated drinks and are also sold to some extent for family use. Five samples were examined.

Detailed descriptions of all these samples are given in the tables on pages 117 to 128. Those in which artificial flavors, artificial dyes, preservatives and glucose were not detected are classed as not found adulterated, and the others, whether found to contain one or more of these materials, are classed as adulterated.

Partial quantitative chemical analyses of these samples and of twelve samples of pure fruit juices from manufacturers, and of five samples prepared in the laboratory, are given in Table XIV, pp. 134 to 137, and are of interest chiefly to food chemists.

Following is a classified list of samples not found adulterated and of those found adulterated, together with the names of the foreign materials detected: where boric acid was found no attempt was made to determine whether it existed free or in form of borax.

TABLE VI—SUMMARY OF RESULTS OF EXAMINATION OF FRUIT SYRUPS AND JUICES AND OF BOTTLED CARBONATED DRINKS.

	Not found Adulterated.	Adulterated.	Total.	Adulterants detected.
Soda Water Syrups:				
(Sold at Soda Fountains.)				
Cherry	0	2	2	Artificial coloring matter.
Mint	0	2	2	Coal-tar dyes.
Orange	1	5	6	Coal-tar dyes, salicylic acid, glucose.
Pineapple	5	1	6	Glucose.
Raspberry	15	17	32	Artificial flavoring, coal-tar dyes, salicylic acid, glucose.
Strawberry	10	26	36	Artificial flavoring, coal-tar dyes, salicylic acid, glucose.
Miscellaneous	5	3	8	Coal-tar dyes.
Total	36	56	92	
Bottled Syrups:				
Orange	2	2	4	Coal-tar dyes.
Pineapple	0	2	2	Salicylic acid.
Raspberry	3	4	7	Artificial flavoring, coal-tar dyes, salicylic acid, benzoic acid, glucose.
Strawberry	2	3	5	Coal-tar dyes, cochineal, salicylic acid, benzoic acid.
Miscellaneous	1	4	5	Coal-tar dyes, salicylic acid.
Total	8	15	23	
Fruit Juice:				
Grape	0	3	3	Salicylic acid, benzoic acid.
Miscellaneous	0	2	2	Salicylic acid.
Total	0	5	5	
Bottled Carbonated Drinks:				
Birch Beer	7	1	8	Salicylic acid.
Cream Soda	6	1	7	Salicylic acid.
Ginger Ale	14	9	23	Salicylic acid, boric acid.
Lemon Soda	7	2	9	Salicylic acid, boric acid.
Orange Soda	0	7	7	Coal-tar dyes, salicylic acid.
Root Beer	8	1	9	Salicylic acid.
Strawberry	0	5	5	Artificial flavoring, coal-tar dyes, salicylic acid.
Sarsaparilla	14	2	16	Salicylic acid, boric acid.
Miscellaneous	1	5	6	Artificial flavoring, coal-tar dyes, salicylic acid.
Total	57	33	90	
Total, syrups, juices and drinks	101	109	210	

The samples examined, with seven exceptions, were sweetened with cane sugar, but in many cases, owing, doubtless, to the presence of organic acids and the process of sterilization employed, this cane sugar had been converted wholly or in part into "invert sugar." This change is not objectionable, as the sweetening matter of most fruits is "invert sugar," and the cane sugar added to fruits in the preparation of preserves, jellies, etc., is partially converted into "invert sugar" during the process.

The sweetening of one sample of bottled syrup, No. 11027, was glucose syrup.

Two samples of bottled syrup and five samples of soda water syrup contained glucose, together with cane and invert sugar. Sweeteners other than sugar were not found.

Of the 71 adulterated syrups, sold at fountains and in bottles, 24 contained artificial flavoring matter; 45, coal-tar dyes; 7, cochineal; 19, salicylic acid, and 2, benzoic acid. Four samples of fruit juices contained salicylic acid, and one benzoic acid. Of the 33 adulterated carbonated drinks (sold in bottles), 6 contained artificial flavoring matter; 15, coal-tar dyes; 16, salicylic acid, and 4, boric acid.

Among the coal-tar dyes identified were magenta, acid magenta, eosine, tropæolin, ponceau, Bordeaux red and anilin green. The quantity in a glass of soda water (250 cc.) or in the syrup for a glass of soda water was, in many cases, sufficient to dye a six-inch square of white woolen cloth (Nun's veiling) a most brilliant color,—scarlet, magenta, crimson, orange, or green, according to the dye.

Tests were made for formaldehyde and sulphurous acid, but neither of these chemical preservatives was detected.

TABLE VII.—SODA WATER SYRUPS NOT FOUND ADULTERATED.

Station No.	Sold for	Dealer.
9904	Coca-Cola	*New Haven.* H. Good, 29 Dixwell Ave.
11093	Cycler's Aid	*New Britain.* J. W. Carter, Elm & Park Sts.
11097	Fruitina	Bergquist Bros., 30 Church St.
9783	Neapolitan Phosphate	*Waterbury.* Chas. Musanti, 100 E. Main St.
11105	Orange	Briggs' Pharmacy, N. Willow & W. Main Sts.
11053	Pineapple	*Groton.* C. T. Davis, 91 Thames St.
11098	"	*New Britain.* C. E. McEnroe, 51 Church St.
11059	"	*Norwich.* Smith's Pharmacy, 205 Main St.
11075	"	*Willimantic.* J. T. Baker, 780 Main St.
11076	"	F. Rogers, 708 Main St.
9905	Queen Sherbet	*New Haven.* H. Good, 29 Dixwell Ave.
11018	Raspberry	*Bridgeport.* E. H. Hurd, 197 Noble Ave.
11123	"	*Danbury.* Bodine's Pharmacy, 258 Main St.
11120	"	New York Candy Kitchen, 238 Main St.
11024	"	*Meriden.* V. W. Schmellzer, 19 E. Main St.
11081	"	*Middletown.* Candy Kitchen, 200 Main St.
11086	"	J. W. Steuck, Main & Washington Sts.
11141	"	*New Haven.* Howe & Stetson, 767 Chapel Sts.
11145	"	Mendel & Freedman, 772 Chapel St.
11054	"	*New London.* R. D. Taylor, 13 Broad St.
11055	"	Crystal Candy Kitchen, 82 State St.
11065	"	*Norwich.* E. A. Small, 118 Franklin St.
11064	"	Woodworth & Small, Main & Thames Sts.
11106	"	*Waterbury.* Joslin & Allen, 171 Bank St.
11111	"	Palace Confectionery Co., 123 Bank St.
11077	"	*Willimantic.* C. E. Whittemore, 759 Main St.
11017	Strawberry	*Bridgeport.* ———, Fairfield Ave. & Water St.
11118	"	*Danbury.* D. A. David, 292 Main St.
11039	"	*Hartford.* Condos & Co., 226 Asylum St.
11041	"	Williams, 975 Main St.
11094	"	*New Britain.* E. W. Thompson & Co., 181 Main St.
11057	"	*New London.* Moon's Pharmacy, 477 Bank St.
11056	"	C. M. Rogers, 9 Main St.
11058	"	*Norwich.* Anthony & Traggis, 191 Main St.
11080	"	*Willimantic.* J. Hickey & Co., 84 Union St.
11078	"	Thread City Candy Kitchen, 661 Main St.

TABLE VIII—ADULTERATED

Station No.	Sold for	Dealer.
11143	Cherry	*New Haven.* R. Ginzberg, 610 Grand Ave
9992	Cherry Ripe	*Waterbury.* Anthony Deo, 84 Canal St.
11004	Miner's Fruit Nectar	*Norwalk.* H. A. Smith, 41 Main St.
11084	Kolafra	*Middletown.* J. J. Murphy, 532 Main St.
11042	Brady's Iced Mint	*Hartford.* E. Scholl Co., 815 Main St.
9969	Miner's Iced Mint	*Meriden.* W. H. Thompson, 75 W. Main St.
11121	Orange	*Danbury.* T. C. Casassa, 3 White St.
11122	"	—— ——, 165 Main St.
11030	"	*Meriden.* J. F. Dooley, 48 E. Main St.
11010	"	*South Norwalk.* Lane's Bakery, 51 Washington St.
9991	"	*Waterbury.* Anthony Deo, 84 Canal St.
11046	Pineapple	*New London.* Anthony & Traggis, 186 State St.
11152	Raspberry	*Bridgeport.* —— ——, 610 E. Main St.
11119	"	*Danbury.* —— ——, 109 Main St.
11040	"	*Hartford.* C. H. Bell, 639 Main St.
11158	"	H. Block, 72 Temple St.
11044	"	Paul Werder, 737 Main St.
11095	"	*New Britain.* G. E. Bunny, Main and W. Main Sts.
11092	"	Rosasco & Curroni, 271 Main St.
11142	"	*New Haven.* Bakery, 657 Grand Ave.
11133	"	C. P. Holmes, 914 State St.
11148	"	S. Pickus, 46 Oak St.
11139	"	M. L. Shorr, 787 Grand Ave.
11003	"	*Stamford.* Parker & Ward, 185 Main St.
11107	"	*Waterbury.* M. K. Lillian, 143 E. Main St.
11109	"	—— ——, 775 Bank St.
11023	"	*Wallingford.* J. F. Cassin, 38 Center St.
11022	"	Shortell's Pharmacy, 72 Center St.
11149	"	*West Haven.* Putman's Restaurant, Beach St.
11153	Strawberry	*Bridgeport.* C. Ferrondo, 699 E. Main St.
11043	"	*Hartford.* O. Coldezky, 68 Morgan St.
11159	"	J. Katz, 215 Front St.
11154	"	—— ——, 164 Front St.
11157	"	—— ——, 170 State St.
11082	"	*Middletown.* Buel & Blatchley, 246 Main St.
11083	"	John Tosillo, 280 Main St.
11096	"	*New Britain.* J. F. Burns, 365 Main St.
11091	"	Rosasco & Caroni, 271 Main St.
11131	"	*New Haven.* Cedar Hill Exchange, 1132 State St.
11138	"	Klondike Candy Kitchen, 459 State St.
11134	"	Schultz Grocery, 802 Grand Ave.
11144	"	Smoleroff Branch, 603 Grand Ave.
11132	"	M. Smoleroff, 932 State St.
11140	"	John Spires, 696 Grand Ave.
11135	"	—— ——, 794 Grand Ave.
11137	"	—— ——, 885 Grand Ave.
11151	"	—— ——, 56 Oak St.
11063	"	*Norwich.* James Costandi, 263 Main St.
11062	"	B. A. Herrick, Broadway and Main St.
11085	"	*Portland.* Geo. W. Lord, Main St.
11002	"	*Stamford.* J. K. Lawrence, 55 Atlantic St.
9993	"	*Waterbury.* Anthony Deo, 84 Canal St.
11108	"	G. T. Geddes, 826 Bank St.
11110	"	Waterbury Candy Kitchen, 128 S. Main St.
11150	"	*West Haven.* Fred's Quick Lunch, Savin Rock Grove
11147	" Violetene	*New Haven.* V. Amarante, 63 Congress Ave.

Soda Water Syrups.

Flavoring matter.	Coloring matter.	Preservative.	Sugar.
----	Artificial	----	Cane sugar.*
----	Artificial	----	"
----	Artificial	----	"
----	Coal-tar dye	Salicylic acid	"
----	Green coal-tar dye	----	
----	Green coal-tar dye	----	
----	Orange coal-tar dye	----	Cane sugar and glucose.
----	----	----	Cane sugar and glucose.
----	Orange coal-tar dye	Salicylic acid	Cane sugar.*
----	Cochineal	----	"
----	Orange coal-tar dye	----	"
----	----	----	Cane sugar and glucose.
----	Magenta†	----	Cane sugar.*
Artificial	Crimson coal-tar dye	----	"
----	----	Salicylic acid	"
Artificial	----	----	"
----	Crimson coal-tar dye	----	"
----	Cochineal	----	"
Artificial	Violet dye	----	"
Artificial	Crimson coal-tar dye	----	"
----	Red coal-tar dye	----	Cane sugar and glucose.
Artificial	Acid magenta†	----	Cane sugar.*
Artificial	Crimson coal-tar dye	----	"
----	Red coal-tar dye	Salicylic acid	"
----	----	Salicylic acid	"
----	Crimson coal-tar dye	Salicylic acid	"
----	----	Salicylic acid	"
----	Magenta†	----	"
Artificial	Cochineal	----	"
Artificial	Crimson coal-tar dye	----	"
----	Magenta†	----	"
Artificial	Crimson coal-tar dye	----	"
Artificial	Magenta†	----	"
Artificial	Crimson coal-tar dye	----	"
----	Magenta†	----	"
----	Crimson coal-tar dye	----	"
----	Magenta†	----	"
Artificial	Eosine†	----	"
Artificial	Crimson coal-tar dye	----	"
Artificial	Eosine†	----	Cane sugar and glucose.
Artificial	Crimson coal-tar dye	----	Cane sugar.*
Artificial	Cochineal	----	"
Artificial	Cochineal	----	"
----	Scarlet coal-tar dye	----	"
Artificial	Red coal-tar dye	----	"
----	Acid magenta†	----	"
Artificial	Crimson coal-tar dye	----	"
Artificial	Scarlet coal-tar dye	----	"
----	----	Salicylic acid	"
----	Scarlet coal-tar dye	Salicylic acid	"
----	Red coal-tar dye	Salicylic acid	"
Artificial	Crimson coal-tar dye	----	"
----	----	Salicylic acid	"
Artificial	Magenta†	----	"
Artificial	Cochineal	----	"
----	Green coal-tar dye	----	"

* Partially inverted. † A coal-tar dye.

TABLE IX.—BOTTLED FRUIT SYRUPS NOT FOUND ADULTERATED.

Station No.	Brand.	Dealer.		Price per bottle, cents.	Quantity in bottle, ounces.
	Claret Lemonade.				
9945	Bain & Chapman Mfg. Co., St. Louis	*New Haven.*	Johnson & Bro., Court & State Sts.	25	
	Orange Lemonade.				
9946	Meyer Bain Mfg. Co., St. Louis		Johnson & Bro., Court & State Sts.	25	
	Blood Orange.				
9959	Thompson, New York, N. Y.	*So. Norwalk.*	Chas. E. Seymour, 33 Washington St.	25	
	Raspberry.				
9989	Steele Bros., New Britain	*Middletown.*	A. G. McKee, 264 Main St.	75	32
9958	Thompson's Fruit Syrup, New York	*So. Norwalk.*	Chas. E. Seymour, 33 Washington St.	25	
9953	C. T. Joslyn Co., Malden, Mass.	*Stamford.*	Kirk & Dixon, 38 Atlantic Square	12	
	Strawberry.				
9990	Steele Bros., New Britain	*Middletown.*	A. G. McKee, 264 Main St.	75	32
9954	C. T. Joslyn Co., Malden, Mass.	*Stamford.*	Kirk & Dixon, 38 Atlantic Square	12	

Station No.	Brand.	Dealer.	Price per bottle, cents.	Quant. in bottle, ounces.	Coloring matter.	Preservative.	Sugar.
	Cherry:	*New Haven:*					
9942	True fruit Cherry Shrub, J. Hungerford Smith Co., Rochester, N. Y.	Johnson & Bro., Court and State Sts.	25	16	Crimson coal-tar dye	Salicylic acid	Cane sugar.*
	Claret:						
9937	True fruit Claret Shrub, J. Hungerford Smith Co., Rochester, N. Y.	Johnson & Bro., Court and State Sts.	25	16	Claret	Salicylic acid	"
	Orange:	*Stamford:*					
9951	The Crystal Conserve Co., New York	G.A.Ferris, 184 Main St.	20	7½	Orange coal-tar dye		"
		New Haven:					
9940	True fruit Orange Shrub, J. Hungerford Smith Co., Rochester, N. Y.	Johnson & Bro., Court and State Sts.	25	16	Yellow dye		"
	Pineapple:						
9590	Concent. Pineapple Lemonade, Bain & Chapman Mfg, Co., St.Louis,Mo.	E. E. Hall & Son, 381 State St.	30	--	Pineapple	Salicylic acid	"
9939	True fruit Pineapple Shrub, J. Hungerford Smith Co., Rochester, N.Y.	Johnson & Bro., Court and State Sts.	25	16	Pineapple	Salicylic acid	"
	Raspberry:	*Bridgeport:*					
9961	Philip J. Ritter Conserve Co., Philadelphia, Pa.	Osborne Bros., Noble Ave. and Jane St.	25	16	Scarlet coal-tar dye	Benzoic acid	Cane sugar and glucose.
		Meriden:					
11027	Raspberry	Boston Grocery, 17 Colony St.	10	9			Glucose.
		New Haven:					
9589	Bain & Chapman Mfg. Co., St. Louis, Mo.	E. E. Hall & Son, 381 State St.	30	16	Raspberry	Salicylic acid	Cane sugar.*
9941	True fruit Raspberry Shrub, J. Hungerford Smith Co., Rochester, N.Y.	Johnson & Bro., Court and State Sts.	25	16	Crimson coal-tar dye	Salicylic acid	"
	Root Beer:						
9944	True fruit Root Beer Shrub, J. Hungerford Smith Co., Rochester, N.Y.	Johnson & Bro., Court and State Sts.	25	16		Salicylic acid	"
	Strawberry:						
9943	True fruit Strawberry Shrub, J. Hungerford Smith Co., Rochester, N.Y.	Johnson & Bro., Court and State Sts.	25	16	Scarlet coal-tar dye	Salicylic acid	"
		Bridgeport:					
9962	Philip J. Ritter Conserve Co., Phila., Pa.	Osborne Bros., Noble Ave. and Jane St.	25	16	Scarlet coal-tar dye	Benzoic acid	"
		Meriden:					
11026	Joseph Campbell Preserve Co., Camden, N. J.	Boston Grocery, 17 Colony St.	19	9	Cochineal		Cane sugar and glucose.
	Wild Cherry:	*Stamford:*					
9949	No-Tox Wild Cherry Phosphate, E. S. Burnham Co., New York	W. W. Waterbury, 207 Main St.	22	6	Scarlet coal-tar dye		No sugar.

* Partially inverted.

Station No.	Brand.
	Birch Beer.
9966	Mohican Spring Water Co., Bridgeport
9936	Wait Everett's Birch Beer, New Haven
9579	J. Wahrenberger's Birch Beer, New Haven
9574	G. Mosca & Co., New Haven
9922	Star Bottling Works, New Haven
9912	J. C. Scovill, New Haven
9555	Gilhuly & Bohen, New Haven
	Cream Soda, (Vanilla).
11034	Crystal Spring Soda Works, Meriden
9586	Crystal Springs Cream Soda, Howard & Co., New York
9932	Wait Everett's Cream Soda, New Haven
9578	Chas. Clair's Cream Soda, New Haven
9921	Star Bottling Works, New Haven
9916	J. C. Scovill, New Haven
	Ginger Ale.
9964	Mohican Ginger Ale, Fairfield Spring Water Co., Bridgeport
9960	Fairfield Ginger Ale, Aero Distilled Water Co., Bridgeport
9976	Royal Belfast Ginger Ale, W. A. Ross & Sons Limited, Ireland
9975	Aromatic, M. M. Bacon, Hartford
11033	Crystal Spring Soda Works, Meriden
9931	Wait Everett's Ginger Ale., New Haven
9581	J. Wahrenberger, New Haven
9572	G. Mosca & Co., New Haven
9919	No label
9538	Cantrell & Cochrane, Dublin & Belfast, Ireland
9591	Hygeia Distilled Water Co., New York
9910	J. C. Scovill, New Haven
9528	Glenbrook Spring Ginger Ale, Eagle Bottling Works, Glenbrook
11011	Gray Bros., New Canaan
	Lemon Soda.
9935	Wait Everett's Lemon Soda, New Haven
9582	C. Clair's Lemon Soda, New Haven
9920	Star Bottling Works, New Haven
9918	No label
9553	G. Mosca & Co., New Haven
9814	J. C. Scovill, New Haven
9557	Gilhuly & Bohen, New Haven
9906	*Moxie Nerve Food.* Moxie Nerve Food Co., Boston, Mass.
	Root Beer.
9587	Imperial Brand Root Beer, Franklin Packing Co.
9930	Wait Everett's Root Beer, New Haven
9923	Star Bottling Works, New Haven
9911	J. C. Scovill, New Haven
9556	Gilhuly & Bohen, New Haven
9575	J. Wahrenberger's Root Beer, New Haven
9981	Improved Root Beer, The Chas. E. Hires Co., Phila., Penn.
9980	Famous Root Beer, Geo. A. Berry & Co., Concord, N. H.
	Sarsaparilla.
9965	Mohican Spring Water Co., Bridgeport
11031	Crystal Spring Soda Works, Meriden
9585	Crystal Springs Sarsaparilla, Howard & Co., New York
9933	Wait Everett's Sarsaparilla, New Haven
9542	Cliquot Club Bottling & Extract Co., Millis, Mass.
9580	J. Wahrenberger, New Haven
9573	G. Mosca & Co, New Haven
9917	No label
9928	Hygeia Distilled Water Co., New York
9913	J. C. Scovill, New Haven
9558	Gilhuly & Bohen, New Haven
9598	Delatour Extra, Ackley C. Schuyler, New York
11014	H. G. & G. S. Grumman, Norwalk
11012	Gray Bros., New Canaan

Dealer.	Price per bottle, cents.	Quantity in bottle, pints.
Bridgeport. R. T. Whiting, 345 Main St.	10	⅔
New Haven. I. B. Chandler, 7 Shelton Ave	10	2
Elm City Bottling Works, 745 Dixwell Ave.	7*	2
———, State & Clark Sts.	10	2
H. Grau, 15 Dixwell Ave.	10	2
J. C. Scovill, 171 Kimberly Ave.	5*	½
C. B. Vandine, 894 State St.	10	2
Meriden. —— ——, 37 State St.	5	½
New Haven. S. S. Adams, Court & State Sts.	5	⅔
I. B. Chandler, 7 Shelton Ave.	10	2
Elm City Bottling Works, 745 Dixwell Ave.	7*	2
H. Grau, 15 Dixwell Ave.	10	2
J. C. Scovill, 171 Kimberly Ave.	10	2
Bridgeport. The Coe & White Co., 560 Main St.	10	⅔
Osborne Bros., Noble Ave. & Jane St.	5	⅔
Hartford. Boston Branch, 751 Main St.	13	⅔
G. C. Loeffler, 705 Main St.	10	⅔
Meriden. —— ——, 37 State St.	5	½
New Haven. I. B. Chandler, 7 Shelton Ave.	10	2
Elm City Bottling Works, 745 Dixwell Ave.	3*	½
———, 858 State St.	5	½
H. Grau, 15 Dixwell Ave.	5	⅔
Howe & Stetson, 767 Chapel St.	10	⅔
W. S. Prindle, Church & George Sts.	10	⅔
J. C. Scoville, 171 Kimberly Ave.	3*	½
Sparks & Co., 856 Chapel St.	10	¾
So Norwalk. L. Paganetti, 53 Washington St.	5	½
New Haven. I. B. Chandler, 7 Shelton Ave.	10	2
Elm City Bottling Works, 745 Dixwell Ave.	3*	½
H. Grau, 15 Dixwell Ave.	10	2
H. Grau, 15 Dixwell Ave.	5	⅔
———, State & Clark Sts.	10	2
J. C. Scovill, 171 Kimberly Ave.	3*	½
C. B. Vandine, 894 State St.	10	2
J. Coburn, College & Chapel Sts.	25	
S. S. Adams, Court & State Sts.	5	⅔
I. B. Chandler, 7 Shelton Ave.	10	2
H. Grau, 15 Dixwell Ave.	10	2
J. C. Scovill, 171 Kimberly Ave.	3*	½
C. B. Vandine, 894 State St.	10	2
J. Wahrenberger, 745 Dixwell Ave.	7*	2
Norwich. W. A. Smith, 135 Main St.	10	1⅓
Steiner's Pharmacy, Main & Shetucket Sts.	20	2
Bridgeport. R. T. Whiting, 345 Main St.	10	⅔
Meriden. I. Dondero, 306 E. Main St.	5	½
New Haven. S. S. Adams, Court & State Sts.	5	⅔
I. B. Chandler, 7 Shelton Ave.	10	2
C. F. Curtiss, 950 State St.	10	¾
Elm City Bottling Works, 745 Dixwell Ave.	7*	2
———, 858 State St.	10	2
H. Grau, 15 Dixwell Ave.	5	⅔
W. S. Prindle, Church & George st.	10	⅔
J. C. Scovill, 171 Kimberly Ave.	3*	½
C. B. Vandine, 894 State St	10	2
New London. Downey & Kinney, 134 State St.	10	1⅓
So. Norwalk. Daniel L'Homedieu, Washington St.	5	½
L. Paganetti, 53 Washington St.	5	½

* By the dozen.

TABLE XII—SODA WATER AND OTHER CARBONATED BEVERAGE

Station No.	Brand.	Dealer.
	Birch Beer:	*New Haven:*
9565	John Clancey, New Haven	Gibbons Bros., State and Pearl Sts.
	Century:	
9934	Wait Everett, New Haven	I. B. Chandler, 7 Shelton Ave.
	Crab Apple Tonic:	
9545	John Clancey, New Haven	David Kligerman, 13 Lawrence St.
	Cream Soda:	
9562	John Clancey, New Haven	Gibbons Bros., State and Pearl Sts.
	Dewey Soda:	
9927	Star Bottling Works, New Haven	Star Bottling Works, 24 Dow St.
	Ginger Ale:	
9571	Crystal Springs Ginger Ale, Howard & Co., New York	S. S. Adams, 412 State St.
9938	Delatour Extra, Ackley C. Schuyler, New York	E. E. Hall & Son, 381 State St.
9530	Sparkling, Vartray Water Co., Buffalo, N. Y.	E. E. Hall & Son, 381 State St.
9536	Arethusa Spring Water Co., Seymour	Hauff Bros., Church and Chapel Sts.
9584	Countess, Hygeia Ice and Water Co., New Haven	Heublein & Bro., Court and Church Sts
9540	Naugatuck Diamond, Diamond Bottling Co., Waterbury	E. Hewitt & Co., 744 Chapel St.
9534	Naugatuck Diamond, Diamond Bottling Co., Waterbury	Harry Leigh & Bronson Co., 354 State St
9552	John Clancey, New Haven	J. J. Sullivan, Nash and Eagle Sts.
9956	Cliquot Club Bottling and Extract Co., Millis, Mass.	*South Norwalk:* F. D. Lawton & Co., 22 Main St.
	Lemon Soda:	
9570	Lemonade, Arethusa Spring Water Co., Seymour	*New Haven:* Gilbert & Thompson, 918 Chapel St.
9546	John Clancey, New Haven	David Kligerman, 13 Lawrence St.
	Orange:	
9929	Orange Phosphate, Wait Everett, New Haven	I. B. Chandler, 7 Shelton Ave.
9576	J. Wahrenberger, New Haven	Elm City Bottling Works, 745 Dixwell Av
9955	Blood Orange, Cliquot Club Bottling and Extract Co., Millis, Mass.	*South Norwalk:* F. D. Lawton & Co., 22 Main St.
		New Haven:
9583	C. Clair, New Haven	Elm City Bottling Works, 745 Dixwell Av
9925	Star Bottling Works, New Haven	H. Grau, 15 Dixwell Ave.
9550	Blood Orange Phosphate, John Clancey, New Haven	J. J. Sullivan, Nash and Eagle Sts.
9559	Gilhuly & Bohen, New Haven	C. B. Vandine, 894 State St.
	Phosa:	
9597	Rumford Chemical Works, Providence, R. I.	*New London:* ——, 56 Main St.
	Raspberry:	*New Haven:*
9561	Gilhuly & Bohen, New Haven	C. B. Vandine. 894 State St.
	Root Beer:	
9564	John Clancey, New Haven	Gibbons Bros., State and Pearl Sts.
	Sarsaparilla:	
9569	Arethusa Spring Water Co., Seymour	Gilbert & Thompson, 918 Chapel St.
9952	Naugatuck Boy Brand, Diamond Bottling Co., Waterbury	*Norwalk:* H. A. Smith, 41 Main St.
	Strawberry:	*New Haven:*
9563	John Clancey, New Haven	Gibbons Bros., State and Pearl Sts.
9924	Star Bottling Works, New Haven	H. Grau, 15 Dixwell Ave.
9915	J. C. Scovill, New Haven	J. C. Scovill, 171 Kimberly Ave.
9554	G. Mosca & Co., New Haven	——— State and Clark Sts.
		South Norwalk:
11013	H. J. and G. S. Grumman, Norwalk	Daniel L'Homedieu, Washington St.

ONTAINING ANTISEPTICS, ARTIFICIAL DYES OR FLAVORS.

per bottle. cents.	Quant. in bottle. Pints.	Flavoring matter.	Coloring matter.	Preservative.	Sugar.
10	2			Salicylic acid	Cane Sugar.*
10	2		Scarlet coal-tar dye		"
10	2	Artificial		Salicylic acid	"
10	2	Vanilla		Salicylic acid	"
10	2		Red coal-tar dye		"
5	⅔	Ginger		Salicylic acid	"
10	⅔	"		Salicylic acid	"
10	⅔	"		Salicylic acid	"
10	⅔	"		Boric acid	"
15	⅔	"		Boric acid	"
10	⅔	"		Salicylic acid	"
10	⅔	"		Salicylic acid	"
10	2	"		Salicylic acid	"
12	¾	"		Salicylic acid	"
10	⅔	Lemon		Boric acid	"
10	2	"		Salicylic acid	"
10	2	Orange	Orange coal-tar dye		"
7‡	2	"	Crimson coal-tar dye		"
12	¾	"	Scarlet coal-tar dye		"
3‡	½	"	Crimson coal-tar dye		"
10	2	"	Orange coal-tar dye		"
10	2	"	Acid magenta†	Salicylic acid	"
10	2	"	Acid magenta†		"
10	⅔			Salicylic acid	"
10	2	Artificial	Acid magenta†		"
10	2			Salicylic acid	"
15	⅔			Boric acid	"
10	⅔			Salicylic acid	"
10	2	Artificial	Acid magenta†	Salicylic acid	"
10	2	Artificial	Scarlet coal-tar dye		"
3‡	½		Crimson coal-tar dye		"
10	2	Artificial	Acid magenta†		"
5	½	Artificial	Crimson coal-tar dye		"

* Partially inverted. † A coal-tar dye. ‡ By the dozen.

TABLE XIII.—FRUIT JUICES CONTAINING CHEMICAL PRESERVATIVES.

Station No.	Brand.	Dealer.	Price per bottle, cents.	Quantity in bottle, ounces.	Preservative.	Sugar.
	Grape Juice.	*Meriden.*				
9970	Concord Snow Grape Juice Co.. Penn Yan, N. Y.	Russell Bros., W. Main & Colony Sts.	20	16	Salicylic acid	Invert sugar
		New Haven.				
9566	Welch Grape Juice Co., Westfield, N. Y.	Mendel & Freedman, 772 Chapel St.	25	17	Salicylic acid	"
9907	Philip J. Ritter Conserve Co., Phila., Penn.	D. M. Welch, Congress Ave. & Commerce St.	25	13	Benzoic acid	"
	Montego Lime Juice.					
9909	Jamaica, West Indies	D. M. Welch, Congress Ave. & Commerce St.	10	16	Salicylic acid	"
	Raspberry Juice.	*Willimantic.*				
9986	Hance Bros. & White, Phila., Penn.	Dennis Shea, 726 Main St.	60	28	Salicylic acid	"

Methods of Examination.

A carbonated beverage is transferred to a flask and shaken at intervals during several hours. The liquid, which is then nearly free from carbonic acid, is used for the examination. Syrups, of course, do not require this preliminary treatment. All samples are kept on ice until used.

Solids. 2 grams of syrup, or 10 grams of carbonated beverage, are evaporated on a water bath and the residue is heated for 2 hours at 100° C. The drying is completed at 110° C.

Acids. A weighed quantity of the material is diluted with water, boiled, if carbonic acid be present, and titrated with standard barium hydrate solution, phenolphthalein being used as an indicator. The results are calculated as citric acid.

Polarization. The normal quantity for polariscopic test (26.048 grams), or, in the case of some of the syrups, one-half the normal quantity, is dissolved in water and clarified when necessary with 1cc. each of alum-cream and basic lead acetate solution. After making up the volume to 100cc. and filtering, the solution is "polarized" in a 200mm. tube.

50cc. of the solution are inverted by heating at 68° to 70° for ten minutes with 5cc. of strong hydrochloric acid. The inverted solution is polarized in a 220mm. tube, at the same temperature employed in the direct observation and, if glucose is present, again at 86° C.

The polariscopic readings in the table are calculated in all cases to the normal quantity.

The following formulae were used for calculating the sucrose and invert sugar from the polariscopic readings:

Let S = per cent. of sucrose,
I = per cent. of invert sugar,
a = direct reading in sugar degrees, with + sign when right-handed and − sign when left-handed.
b = reading in sugar degrees after inversion, always with + sign.
t = temperature C.

Then $S = \frac{100\,(a+b)}{144-\frac{t}{2}}$ (Clerget's formula)

$$I = 1.0526\left(\frac{100\,b}{44-\frac{t}{2}} - S\right) \text{ or } I = \frac{105.26\,(S-a)}{44-\frac{t}{2}}$$

The first of the two formulae for calculating invert sugar was derived by the writers from well known data, the latter from a formula given by Tuchschmid* for calculating *grams* of invert sugar. In Robb and Veley's English edition of Landolt's Handbook of the Polariscope, London, 1882, p. 189, Tuchschmid's formula, without change, is erroneously given for calculation of *percentage* of invert sugar.

*Jour. prakt. Chem. (2), *2*, 235.

In the presence of any considerable amount of glucose or other optically active matter the formulae are not applicable. Tartaric acid, malic acid, some salts of organic acids, lemon oil and other substances contained in fruits, or added separately to soda water, are optically active, but the specific rotation of most of these is much less than of the sugars and they are present usually in very small amount.

In grape and quince juice, as will be seen by referring to the analyses, the sum of the sucrose and invert sugar, as calculated by formulae, is greater than the percentage of solids. This is due to some body, present in these juices, which polarizes to the left at 86° C. The fruit juices used in the kinds of soda water and syrups examined, give as a rule, a zero reading at 86°, and in these the results calculated by the formulae are not far from correct.

It is evident that the method only gives approximately the quantity of sugar, but indicates whether or not glucose is present.

*Arata's Wool Test for Coal-tar Dyes.** 100cc. of soda water, or 50cc. of syrup diluted to 100cc, are boiled for 10 minutes with 10cc of 10 per cent. solution of potassium bisulphate and a piece of white wool, or woolen cloth, which has been previously heated to boiling in a very dilute solution of sodium hydrate, and thoroughly washed in water. After removal from the solution, the wool is again washed in boiling water and dried between pieces of filter paper. If the coloring matters are entirely from fruit, the wool will either be uncolored, or will take on a faint pink or a brown color, which is changed to green by ammonia and is not restored by washing in water; but acid magenta, tropeolin, ponceau and various azo-colors are fixed on the wool and the color of the latter is either not changed by ammonia, or, if changed, is restored on washing.

Care should be taken to determine whether the wool is dyed, or merely coated with the color. For example, chlorophyl from green coloring preparations of vegetable origin, is deposited on wool, together with fat and resin, but the color, unlike the coal-tar dyes, rubs off on the fingers and is readily washed out with soap and water.

The dye present may often be identified by noting the color of the wool after addition of enough concentrated sulphuric acid to thoroughly moisten the fibres and again after dilution of the acid. In doubtful cases, however, the wool should be treated with dilute tartaric acid solution to remove vegetable colors, washed in water and dried between sheets of filter paper. It is then transferred to a test tube and saturated with concentrated sulphuric acid. After standing 5 or 10 minutes, water sufficient to make 10cc is added and the wool is removed. The solution after neutralizing with ammonia and cooling is shaken with 5 to 10cc. of pure amyl alcohol, to which a few drops of ethyl alcohol are added, to facilitate the separation. The alcoholic extract is

*Ztschr. anal. Chem. *28*, 639. See also Borgman, Anleitung chem. Anal. d. Weines, Wiesbaden, 1898, p. 91. Koenig, Untersuchung landw. u. gewerb. wich. Stoffe, Berlin, 1898, 577.

separated, evaporated to dryness, and the residue tested according to the scheme of Witt,* Weingaertner,† Dommergue,‡ or Girard and Dupré.§

Amyl Alcohol Test, Alkaline Solution.|| 25cc. of the liquid to be tested, made alkaline with ammonia, are shaken cautiously for some minutes in a separatory funnel, with pure amyl alcohol. If the clear alcoholic layer, when separated from the aqueous solution, is colored, or if addition of acetic acid develops a magenta color (fuchsine), a portion of it, together with an equal bulk of water and a thread of wool, is heated on a water bath, the water lost by evaporation being replaced from time to time.

The presence of a coal-tar dye should not be affirmed until the color has been fixed on wool and the wool has been washed in boiling water, dried and tested. When fuchsine is present, the color which appears on adding acetic acid to the alcohol extract is changed to yellow by hydrochloric acid.

Amyl Alcohol Test, Acid Solution. 25cc. of the liquid, to which have been added a few drops of hydrochloric acid, are shaken with amyl alcohol, and dyeing tests are made as described in the preceding section.

A colored amyl alcohol does not prove the presence of a coal-tar color, as we have found that red coloring matters are extracted by this solvent from acid solutions of fruit juices. These solutions, however, do not dye wool, when treated as above described.

Girard's Test for Acid Fuchsine (Acid Magenta).** If a bright magenta color is fixed on wool by Arata's test and if ordinary fuchsine has been proved to be absent, test should be made for acid fuchsine.

To 10cc. of the liquid are added 2cc. or more of 5 per cent.-solution of potassium hydrate. The strongly alkaline liquid is mixed with 4cc of 10 per cent.-solution of mercuric acetate and filtered. The filtrate should be alkaline and colorless. If addition of a slight excess of dilute sulphuric acid produces a violet red coloration and other dyes have not been found by the amyl alcohol test, the presence of acid fuchsine may be affirmed.

Test for Cochineal.†† If amyl alcohol extracts from the liquid after acidifying, an orange color which has not been found to be of coal-tar origin, test is made for cochineal.

The alcohol is washed several times with water and divided into two portions. To one portion is added a solution of uranium acetate, drop by drop, with shaking. In the presence of cochineal the aqueous

*Ztschr. anal. Chem. *26*, 100.

†Ibid., *27*, 232.

‡Ibid., *29*, 369.

§Analyse des Matières Alimentaires et Recherche de leurs Falsification, pp. 583-593.

||Ibid., 167, 582.

**Girard et Dupré, Analyse des Matières Alimentaires et Recherche de leurs Falsification, p. 169.

††Ibid., p. 580.

solution acquires an emerald green color. As a confirmatory test, the other portion is made alkaline with ammonia, which changes the orange color of cochineal to purple.

Vegetable Colors are tested for by the methods described by Girard and Dupré.

Salicylic Acid and Benzoic Acid. Twenty-five to 50cc. of the liquid are thoroughly shaken in a tube of suitable size with an equal bulk of ether. The ethereal solution is carefully decanted into a flat procelain dish and the ether evaporated at a gentle heat. The residue is taken up with absolute alcohol and the solution allowed to evaporate to dryness at the room temperature. The presence of salicylic acid is indicated by the appearance of characteristic fibrous crystals, and that of benzoic acid by shining crystalline scales. The residue is further tested as follows:

Salicylic Acid. A portion of the residue is dissolved in absolute alcohol and tested with ferric chloride solution.

To further confirm the presence of salicylic acid, another portion of the crystalline residue is heated with methyl alcohol and a few drops of sulphuric acid. Methyl salicylate, formed by this treatment, is recognized by its characteristic odor.

Benzoic Acid. A portion of the residue is cautiously heated and if fumes of this acid are given off they are collected on a cool surface. The crystalline sublimate is demonstrated to be benzoic acid by the following tests:

(1.) The melting point is determined.

(2.) Some of the crystals are dissolved in ammonia and the solution evaporated to dryness to remove excess of the alkali. The residue is dissolved in water and divided into two portions. To one portion neutral solution of ferric chloride is added, which gives the flesh-colored precipitate of ferric benzoate. Addition of strong hydrochloric acid decomposes this precipitate with separation of benzoic acid.

(3.) The other portion of the aqueous solution of ammonium benzoate (prepared according to 2) is mixed with an equal bulk of absolute alcohol and a few drops of copper sulphate are added dropwise. A light blue precipitate of cupric benzoate is thus obtained.*

Boric Acid and Borates. A few cc. of the soda water or syrup are mixed with some drops of strong hydrochloric acid and a piece of delicate turmeric paper is moistened with the liquid. In the presence of boric acid the paper acquires, on drying, a peculiar red color, which is changed by ammonia to a dark blue-green, but is restored by acid.

Sulphurous acid and sulphites. 100cc. of the liquid are mixed with 10cc. of a 5 per cent. solution of phosphoric acid and distilled until 10cc. of liquid are carried over. The distillate is boiled with bromine water, to oxidize sulphurous to sulphuric acid, which is detected by addition of barium chloride solution.

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*See Horn, Zeitschr. anal. Chem. *30*, 732.

Formaldehyde. 100 to 200 cc. of the solution are distilled until 10 to 20cc. of distillate are obtained. The latter is tested as follows:*

1. One cc. is mixed in a test tube with 5cc. of pure milk; and an equal volume of 94 per cent. sulphuric acid containing a trace of ferric chloride is added in such a manner that the two do not mix. In the presence of formaldehyde a blue ring forms at the juncture of the liquids.

2. A mixture of 2cc. of the distillate, with 10cc. of milk, 5cc. of concentrated hydrochloric acid and 1 drop of ferric chloride solution, is heated with constant agitation. Formaldehyde causes a violet coloration.

3. Rimini test.† 5cc. of the distillate, diluted to 15cc., are mixed with 1cc. phenylhydrazine hydrochloride solution (4:100), 4 drops of freshly prepared sodium nitroprusside solution (1:200) and enough concentrated solution of sodium hydrate to make the mixture strongly alkaline. Formaldehyde is indicated by the appearance of a blue, or in dilute solutions green, coloration, which changes to red on standing. When formaldehyde is absent, only the red color appears.

Saccharine. The liquid to be tested is shaken for some minutes in a separatory funnel with an equal bulk of ether. The ethereal solution is separated and evaporated to dryness. If an appreciable amount of saccharine is present, the residue will have an intensely sweet taste.

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*For other tests see Jorissen, J. pharm. de Liege, *4*, 257 (Abstract Ztschr. Unters. Nahr. Genuss, *1*, 356.)

Also Wallace and Drescher, N. Y. Dairy Commissioner, Rep. 1898, pp. 42, 58.

†Anal. di Farmacol, 1898, 97. (Abstract Ztschr. Unters. Nahr. Genuss, *1*, 858.)

Table XIV.—Chemical Examination of Fruit Syrups, Fruit Juices and Bottled Beverages.

Station No.		Solids.	Acids other than carbonic calculated as citric acid.	Cane Sugar.	Invert Sugar.	Polarization. Direct.	After Inversion.	Temp. C°.	After inversion. Reading at 86°C.
	Soda Water Syrups not found Adulterated.								
9904	Coca-Cola	57.95	0.4	8.1	42.0	— 5.0	—15.7	22.5	
11093	Cycler's Aid	60.75	.45	8.6	40.8	— 4.0	—15.4	23.	
11097	Fruitina	54.05	.17	45.7	0.0	46.8	—13.2	25.4	
9783	Neapolitan Phosphate	56.40	1.14	8.9	42.1	— 4.0	—15.8	23.4	
11105	Orange	56.14	.14	50.11	0.0	50.4	—15.4	25.4	
11053	Pineapple	65.56	.65	46.62	8.3	44.0	—18.0	22.	
11098	"	51.38	.17	40.53	5.1	39.0	—14.3	25.	
11059	"	58.84	.20	39.15	8.9	36.8	—15.0	25.4	
11075	"	66.98	.14	57.37	----	57.6	—18.5	22.7	
11076	"	59.82	.23	50.27	4.2	49.0	—17.6	23.	
9905	Queen Sherbet	69 68	.57	18.37	42.2	6.0	—18.0	26.5	
11018	Raspberry	56.17	.17	44.15	2.5	43.4	—15.2	22.6	
11123	"	61.00	1.14	0.0	53.6	—16.0	—16.0	25.2	
11120	"	64.46	.74	1.3	54.9	—15.2	—16 9	24.8	
11024	"	55.20	.23	42.83	5.5	41.2	—15.0	25.6	
11081	"	59.85	.62	5.4	52.8	—10.8	—18.0	23.2	
11086	"	68.84	.17	35.43	20.7	29.0	—18.0	22.7	
11141	"	62.04	.40	26.35	24.2	19.2	—15.4	25.5	
11145	"	56.44	.28	23.6	27.3	15.6	—15.2	26.5	
11054	"	40.41	.40	36.1	0.0	36.2	—11.0	26.4	
11055	"	68.06	.57	40.5	21.1	34.2	—18.9	25.5	
11065	"	61.68	.26	56.6	0.0	56.4	—18.7	22.5	
11064	"	54.27	.34	43.1	0.0	43.2	—13.9	22.5	
11106	"	53.71	.57	41.3	7.0	39.2	—15.0	25.4	
11111	"	60.74	.34	46.2	2.0	45.6	—15.4	24.	
11077	"	59.90	.23	22.9	22.3	16.0	—14.3	23.	
11017	Strawberry	52.61	.17	47.8	----	50.0	—13.4	22.6	
11118	"	58.50	.57	43.5	9 0	40.8	—16.3	25.5	
11039	"	61.60	.23	53.6	----	54.0	—16.3	25.6	
11041	"	58.15	.65	18.1	30.6	8.6	—15.4	22.7	
11094	"	65.98	.34	49.7	----	50.0	—15.4	25.	
11057	"	61.21	.05	38.4	14.7	34.0	—16.5	25.	
11056	"	63.56	.23	53.3	0.3	53.2	—16 7	25.5	
11058	"	65.64	.14	36.4	19.3	30.6	—17.2	25.	
11080	"	50.41	.37	42.2	0.6	42.0	—13.9	22.8	
11078	"	66.12	.14	38.2	16.1	33.2	—17.6	22.3	
	Soda Water Syrups Adulterated.								
11143	Cherry Ripe	70.36	.14	54.97	6.7	53.0	—18.9	26.4	
9992	Cherry	47.56	.74	32.4	1.3	32.0	—11.0	22.7	
11004	Fruit Nectar	61.98	.60	7.9	44.7	— 6.0	—16.5	22.5	
11084	Kolafra	47.56	.68	4.7	38.6	— 7.0	—13.2	24.3	
11042	Mint	61.57	.09	40.96	17.0	36.0	—17.6	26.3	
9969	"	65.75	.68	3.6	59.0	—14.0	—18.7	25.	
11121	Orange	64.89	.14	----	----	61.4	—11.7	25.5	5.0
11122	"	66.57	.17	----	----	66.0	— 9.9	27.0	7.0
11030	Orangeade	69 41	.45	58.8	----	60.0	—17.6	24.8	
11010	Orange	52.22	.28	47.47	----	47.8	—14.3	26.4	
9991	"	46.60	.68	----	----	34.0	—11.9	22.8	
11046	Pineapple	74.67	.34	----	----	50.8	— 9.0	27.0	9.0
11152	Raspberry	41.71	.34	37.6	----	38.0	—11.4	25.2	
11119	"	56.81	.03	55.9	----	56.6	—17.2	24.0	
11040	"	61.24	.17	27.1	31.9	17.6	—18.0	25.4	
11158	"	46.87	.28	38.2	2.9	37.4	—12.1	29.0	
11044	"	67.69	.23	----	----	34.4	—11.7	22.9	
11095	"	57.00	.17	46.2	0.7	46 0	—15 4	22.	
11092	"	53.71	.03	24.61	29.6	15.8	—16.5	25.5	
11142	"	66.24	.20	39.51	19.3	33.8	—18.0	25.8	
11133	"	56.41	.11	----	----	45.0	— 9.6	27.0	6.0

TABLE XIV.—CHEMICAL EXAMINATION OF FRUIT SYRUPS, FRUIT JUICES AND BOTTLED BEVERAGES—*Continued.*

Station No.		Solids.	Acids other than carbonic calculated as citric acid.	Cane Sugar.	Invert Sugar.	Polarization. Direct.	After Inversion.	Temp. C°.	After inversion. Reading at 86°C.
11148	Raspberry	38.63	.14	34.35	----	35.0	—10.0	26.	
11139	"	50.30	.00	46.13	----	46.6	—13.6	27.	
11003	"	60.58	.51	39.07	11.1	35.6	—16.3	22.3	
11107	"	71.53	.45	4.0	65.9	—16.0	—21.3	24.	
11109	"	63.25	.31	45.62	14.6	41.2	—18.9	24.5	
11023	"	57.75	.14	45.55	----	45.4	—14.5	25.	
11022	"	62.09	.62	34.26	22.8	27.6	—17.2	26.5	
11149	"	43.73	.11	35.03	3.7	34.0	—11.4	28.8	
11153	Strawberry	29.46	.26	26.20	1.4	25.8	— 8.1	29.3	
11043	"	23.27	.23	17.22	4.1	16.0	— 6.6	25.6	
11159	"	18.79	.00	17.14	----	17.8	— 4.4	29.	
11154	"	22.10	.09	19.84	----	24.4	— 5.3	29.	
11157	"	30.42	.03	29.70	----	30.0	— 8.8	26.5	
11082	"	57.36	.23	41.78	5.7	40.0	—15.4	22.8	
11083	"	56.49	.40	49.01	0.0	49.0	—15.4	25.2	
11096	"	60.69	.48	50.38	4.1	49.2	—16.7	26.4	
11091	"	55.21	.11	48.51	----	49.0	—14.7	25.4	
11131	"	46.23	.06	38.93	3.1	38.0	—13.0	26.	
11138	"	52.90	.06	----	----	55.4	— 0.7	26.4	12.0
11134	"	20.92	.00	19.57	----	21.0	— 4.6	26.4	
11144	"	56.02	.00	23.20	26.5	15.4	—15.0	26.	
11132	"	59 86	.03	56.61	----	57.6	—16.7	25.5	
11140	"	52.84	.45	34.65	12.5	31 0	—14.3	26.5	
11135	"	29.85	.06	26.54	----	27.0	— 7.7	26.5	
11137	"	37.23	.03	33.13	----	34.2	— 9.2	26.	
11151	"	21.45	.03	18.24	----	18.6	— 5.3	26.	
11063	"	58.66	.03	54.59	----	56.0	—16.5	22.4	
11062	"	58 42	.11	48.31	2.4	47 6	—15.8	25.5	
11085	"	68.35	.51	26.44	35.1	16.0	—18.7	25.5	
11002	"	66,54	.20	52.0	8.0	49.6	—18.7	25.2	
9993	"	45.07	.14	39.77	----	41.0	—11.8	22.5	
11108	"	50.02	.65	32.2	8.7	29.6	—12.8	24.8	
11110	"	67.49	.11	60.90	1.1	60.6	—19.8	24.	
11150	"	56.85	.40	50.77	1.4	50.4	—15.4	28.8	
11147	Violetene	18.98	.06	14.48	0.0	14.4	— 4.4	28.4	
	Bottled Fruit Syrups not found Adulterated.								
9945	Claret	54.48	1.93	.85	48.6	—13.0	—14.1	28.	
9946	Orange	67.35	1.65	8.9	52.4	— 6.0	—17.6	28.	
9959	"	70.30	.62	1.5	69.7	—18.0	—20.0	29.	
9989	Raspberry	58.06	.74	29.7	21.9	23.2	—15.8	25.5	
9958	"	62.12	.85	1.2	62.5	—16.0	—17.6	28.5	
9953	"	67.41	.45	4 1	62.5	—13.6	—18.9	28.4	
9990	Strawberry	56.97	.57	22.24	30.0	13 6	—15.4	27.3	
9954	"	67.21	.40	5 6	60.2	—11.4	—18.7	28.4	
	Bottled Fruit Syrups Adulterated.								
9942	Cherry	65.62	1.53	1.2	64.5	—17.2	—18.7	28.	
9937	Claret	57.47	.19	4.5	50.6	— 9.6	—15.4	29 4	
9951	Orange	62.53	.97	.7	58.6	—16.0	—16.9	28.	
9940	"	64.27	.12	12.6	48.5	— 1.2	—17.6	28.	
9590	Pineapple	64.32	1.42	3.1	58.6	—13.6	—17.6	28.	
9939	"	63.37	1.31	33 41	27.5	25.6	—17.8	28.2	
9961	Raspberry	64 63	1.60	----	----	30.0	— 5.5	30.	10.8
11027	"	68.95	.37	----	----	78.6	76.4	26.	76.0
9589	"	58.34	1.73	.23	51.7	—14.4	—14.7	28.5	
9941	"	64.70	1.82	7.1	55.9	— 8.8	—18.0	28.2	
9944	Root Beer	62.81	.14	39.1	22.8	32 8	—17.6	30.	
9943	Strawberry	66.03	1.56	4.5	----	12.6	—18.3	28.	
9962	"	66.23	.97	16.03	6.8	14.0	— 7.0	26.	
11026	"	69.56	.11	----	----	14.6	— 7.2	26.5	10.6
9949	Wild Cherry	9.46	12.21	----	----	± 0.0	± 0.0	----	

Table XIV—Chemical Examination of Fruit Syrups, Fruit Juices and Bottled Beverages—*Continued.*

Station No.		Solids.	Acids other than carbonic calculated as citric acid.	Cane sugar.	Invert sugar.	Polarization. Direct.	After inversion.	Temp. C°.	After inversion Reading at 86° C.
	Fruit juices not found adulterated.								
	From Manufacturer.								
9775	Blackberry	5.32	0.65	0.0	4.6	−1.3	−1.3	29.0	
9769	Cherry	14.33	0.80	0.0	6.5	−1.9	−1.9	26.0	
9776	Black Currant	10.00	2.41	0.0	9.2	−2.7	−2.7	26.0	
9771	Red Currant	7.58	2.09	0.0	7.2	−2.1	−2.1	27.0	
9772	Grape	15.29*	0.91	0.0	21.7*	−6.5	−6.5	25.0	−1.0
9773	Lime Fruit	7.78	6.50	0.0	0.0	±0.0	±0.0	----	
9766	Orange	12.72	2.44	0.0	7.1	−2.1	−2.1	26.0	
9774	Pineapple	8.07	0.81	1.5	5.1	±0.0	−2.0	26.0	
9770	Plum	10.81	1.00	0.0	0.3	−0.1	−0.1	26.0	
9768	Quince	10.41*	0.99	0.0	16.7*	−5.0	−5.0	25.0	−2.2
9777	Black Raspberry	8.47	1.36	0.0	7.8	−2.3	−2.3	26.0	
9767	Strawberry	5.69	0.99	0.0	5.1	−1.5	−1.5	26.0	
	Pure Fruit Juices Made in Laboratory.								
9879	Peach	12.70	0.95	5.4	2.1	4.8	−2.2	28.0	±0.0
9880	Red Raspberry	9.41	1.19	0.8	8.6	−1.6	−2.8	26.0	±0.0
9881	Blackberry	8.94	1.22	0.0	8.7	−2.4	−2.4	30.0	±0.0
9882	Huckleberry	11.40*	0.51	0.6	16.7*	−4.0	−4.8	30.0	−1.0
9883	Pineapple	13.90*	0.68	7.4	9.1*	4.7	−4.8	28.0	−0.8
	Fruit Juices Adulterated.								
9970	Grape	21.10	1.00	0.2	27.2	−7.8	−8.0	26.4	
9566	"	19.00	0.87	1.5	22.4	−5.0	−7.0	26.8	
9907	"	23.11	0.84	0.4	25.1	−7.0	−7.5	26.0	
9909	Lime	3.55	3.39	0.0	0.0	±0.0	±0.0	----	
9986	Raspberry	8.94	1.43	0.0	6.6	−2.2	−2.2	26.0	
	Bottled carbonated beverages not found adulterated.								
9966	Birch Beer	11.37	0.04	9.7	0.7	9.5	−3.2	27.	
9936	"	9.74	.03	7.6	0.3	7.5	−2.5	26.	
9579	"	9.69	.04	8.2	0.7	8.0	−2.6	29.5	
9922	"	10.37	.03	8.7	0.0	8.6	−2.6	29.	
9912	"	9.05	.03	7.5	0.7	7.3	−2.5	27.	
9555	"	8.60	.01	6.8	1.4	6.4	−2.5	27.	
9574	"	7.59	.01	5.9	----	6.0	−1.7	25.5	
11034	Cream Soda	11.33	.03	9.1	----	10.0	−2.0	25.5	
9586	"	9.96	.03	8.9	----	9.0	−2.8	24.	
9932	"	8.35	.01	7.1	----	7.5	−1.8	24.	
9578	"	8.20	.01	6.3	0.7	6.1	−2.2	24.	
9921	"	8.94	.04	7.8	----	8.0	−2.2	25.	
9916	"	4.75	.01	4.1	----	4.3	−1.1	26.	
9964	Ginger Ale	12.60	.13	9.0	2.3	8.3	−3 5	25.	
9960	"	9.63	.03	8.1	0.3	8.0	−2.6	25.	
9976	"	6.94	.14	5.4	1.3	5.0	−2.0	26.5	
9975	"	7.97	.07	6.1	1.0	5.8	−2.2	27.	
11033	"	10,94	.11	8.3	1.7	7.8	−3.0	26.5	
9572	"	12.56	.10	7.9	3.0	7.0	−3.4	25.	
9931	"	9.97	.06	8.2	0.7	8.0	−2.8	25.	
9581	"	8.48	.05	6.3	1.0	6.0	−2.3	25.	
9919	"	9.70	.07	6.6	----	7.0	−1.7	25.	
9538	"	9.83	.18	2.2	5.0	0.8	−2.0	30.	
9591	"	8.89	.16	4.5	3.3	3.5	−2.4	25.	
9910	"	7.51	.06	6.3	----	6.6	−1.7	25.	
9528	"	8.52	.08	5.6	1.9	5.0	−2.3	25.	
11011	"	5.05	.03	4.3	1.0	4.0	−1.7	25.	
9935	Lemon Soda	9.09	.05	7.0	0.0	7.0	−2.2	25.	
9582	"	8.05	.03	6.6	1.3	6.2	−2.5	24.	
9920	"	4.83	.05	4.2	----	4.4	−1.1	25.	

* See method of analysis.

TABLE XIV—CHEMICAL EXAMINATION OF FRUIT SYRUPS, FRUIT JUICES AND BOTTLED BEVERAGES—*Continued.*

Station No.		Solids.	Acids other than carbonic calculated as citric acid.	Cane sugar.	Invert sugar.	POLARIZATION. Direct.	After inversion.	Temp. C°.	After inversion Reading at 86° C.
9918	Lemon Soda	8.19	.08	7.1	0.0	7.1	—2.2	25.	
9557	"	10.60	.08	8.8	0.7	8.6	—3.0	24.	
9553	"	9.04	.06	7.4	0.3	7.3	—2.5	24.	
9914	"	8.51	.05	7.2	0.7	7.0	—2.5	24.	
9906	Moxie	8.48	.06	10.9	4.6	9.6	—4.4	30.	
9587	Root Beer	8.32	.01	7.2	0.7	7.0	—2.4	25.5	
9930	"	6.02	.06	0.0	9.4	—2.6	—2.6	30.	
9923	"	8.87	.01	5.8	2.6	5.0	—2.6	25.5	
9911	"	12.75	.06	9.0	1.7	8.5	—3.3	25.5	
9556	"	10.79	.01	8.8	1.0	8.5	—3.0	26.5	
9575	"	8.28	.03	7.3	1.0	7.0	—2.5	26.	
9981	"	4.82	.01	2.8	1.0	2.5	—1.2	25.	
9980	"	10.27	.01	9.4	----	9.5	—2.9	24.	
9965	Sarsaparilla	10.19	.03	7.5	----	7.5	—2.3	25.	
11031	"	10.16	.03	7.4	----	7.9	—1.9	24.	
9585	"	9.78	.03	7.1	0.0	7.1	—2.2	25.	
9933	"	9.49	.01	7.2	----	7.5	—2.0	25.	
9542	"	14.73	.02	11.4	0.0	11.7	—3.3	25.5	
9580	"	7.10	.01	5.3	----	5.6	—1.4	24.2	
9917	"	10.30	.03	7.4	0.0	7.4	—2.3	25.	
9573	"	7.12	.01	5.6	0.0	5.7	—1.7	24.4	
9928	"	9.52	.01	7.2	0.0	7.3	—2.2	25.4	
9913	"	8.43	.02	6.4	0.0	6.4	—2.1	23.	
9558	"	10.34	.01	7.38	0.3	7.3	—2.4	25.	
9598	"	9.92	.11	2.5	1.6	2.0	—1.3	25.	
11014	"	9.76	.01	7.74	0.2	8.0	—2.2	24.4	
11012	"	5.41	.01	3.3	0.7	3.5	—0.9	25.	
	Adulterated Bottled Soda Water.								
9565	Birch Beer	8.87	.08	5.6	0.3	5.5	—1.8	29.	
9934	Century	8.46	.04	7.0	0.3	6.9	—2.3	25.	
9545	Crab-apple Tonic	7.53	.17	2.54	4.3	1.3	—2.0	28.5	
9562	Cream Soda	9.23	.09	5.9	0.0	5.5	—2.4	24.	
9927	Dewey Soda	9.75	.11	7.4	1.3	7.0	—2.8	25.	
9571	Ginger Ale	11.20	.24	6.3	4.3	5.0	—3.3	25.	
9938	"	9.52	.15	7.6	0.3	7.5	—2.5	25.	
9530	"	11.12	.27	5.3	5.5	3.7	—3.3	25.	
9536	"	9.42	.22	6.00	2.3	5.3	—2.6	25.	
9584	"	10.18	.52	0.7	11.3	—2.4	—3.3	30.	
9540	"	9.70	.14	2.8	6.7	0.8	—2.9	25.	
9534	"	10.69	.14	4.64	4.4	3.3	—2.8	25.	
9552	"	7.75	.12	4.71	2.3	4.0	—2.2	25.	
9956	"	10.40	.08	8.00	1.6	7.5	—3.0	25,	
9570	Lemonade	13.48	.32	0.2	10.9	—3.1	—3.4	24.	
9546	Lemon Soda	7.80	.11	5.30	1.0	5.0	—2.0	24.	
9929	Orange	9.09	.10	6.14	1.0	5.8	—2.3	24.	
9576	"	7.54	.03	6.38	0.2	6.3	—2.1	24.6	
9955	"	15.08	.16	7.83	4.1	6.6	—3.7	25.	
9583	"	9.48	.04	7.3	0.3	7.2	—2.4	25.	
9925	"	9.67	.11	7.37	0.7	7.1	—2.6	25.	
9550	"	9.40	.13	5.4	2.4	4.7	—2.4	25.7	
9559	"	9.59	.09	7.45	0.7	7.3	—2.5	25.	
9597	Phosa	13.03	.27	0.3	11.1	—3.0	—3.4	25.5	
9561	Raspberry	9.14	.08	6.62	1.3	6.2	—2.5	25.2	
9564	Root Beer	7.72	.06	3.6	3.8	2.5	—2.2	27.	
9569	Sarsaparilla	9.91	.13	4.47	3.3	3.5	—2.4	24.2	
9952	"	9.65	.08	2.47	5.3	1.0	—2.2	28.5	
9563	Strawberry	7.01	.13	3.43	3.1	2.5	—2.0	25.5	
9924	"	9.42	.09	7.07	0.3	7.0	—2.3	25.	
9915	"	8.48	.05	6.59	0.3	6.5	—2.2	24.2	
9554	"	7.32	.06	5.41	1.0	5.1	—2.0	25.6	
11013	"	9.88	.03	8.38	0.0	8.4	—2.6	25.5	

PEANUT BUTTER AND PEANOLIA.

By A. L. Winton.

Peanut Butter, No. 9749, is made by the Atlantic Peanut Refinery, 145 South Front st., Philadelphia.

It claims to contain nothing but the peanut and salt. "It is not a roasted peanut mixed with oil and salt, but is prepared by a new "German Process." This sample was bought of Johnson & Bro., State st., New Haven, for 25 cents per one-half pound.

Peanolia, "a refined Peanut Butter," No. 9748, is made by the Peanolia Food Co., 106 Park st., New Haven. Bought of E. E. Nichols, New Haven. Price, 25 cents per one-half pound.

Neither of these articles was found to contain either boracic, salicylic, or benzoic acids.

Their analyses are as follows:

Analyses of Peanut Butter and Peanolia.

	Peanut Butter. No. 9749.	Peanolia. No. 9748.
Water	2.10	1.98
Salt	3.23	4.95
Other mineral matters	0.80	1.08
Protein	28.66	29.94
Fiber	2.30	2.10
Starch	6.15	5.58
Sugars, dextrines, etc.	6.13	5.63
Fat	46.41	46.68
Other matters by difference	4.22	2.06
	100.00	100.00

Protein is calculated by multiplying the total nitrogen present by 6.25. Starch was determined by the diastase method. Sugar, dextrines, etc. represent matters soluble in water, hydrolyzed with acid, and calculated as dextrose from their copper-reducing power.

These two preparations are very much alike in composition, rich in protein, or "flesh-forming" material, and in fat.

CHEMICAL PRESERVATIVES.

By E. H. Jenkins, W. L. Mitchell and A. W. Ogden.*

In the Second Report on Food Products the Director of this Station has discussed the nature of these preservatives and the reasons why the extensive and rapidly increasing use of them has become a serious evil.

These reasons may be briefly summarized as follows:

Any preservative operates by destroying the life or suspending the activity of those organisms which cause decay, fermentation and putrefaction.

Antiseptics are, accordingly, for the most part decided poisons. In a certain dilution, with water for example, they may counteract or kill the lower, weak organisms of fermentation and putrefaction without apparent injury to the higher and stronger plants and animals. Whether an antiseptic shall operate as a harmless preservative, or as an unhealthful or even fatal poison in any case, depends upon the quantity and frequency of the dose.

The power of different, apparently well, persons to overcome the action of the common antiseptics, salt, vinegar, wood-smoke and alcohol, and to carry on the digestive processes under their influence, is very various, some suffering no inconvenience from doses which seriously hinder digestion or disturb the health of others.

This statement is equally true of the newer preservatives that are now so extensively and surreptitiously used, viz., borax, formaldehyde, boric, salicylic and benzoic acid.

But a dangerous difference between the long-used and familiar antiseptics and the newer preservatives lies in the fact that while the former are at once recognized by taste or smell, the latter are usually undiscoverable by the senses and their presence in any article of food can only be make known to the consumer by the explicit statement of the producer or by the tests of a chemist.

*The determinations of boric acid and salt in the preservatives discussed in this paper were made by Mr. Mitchell, the analyses of the preparations containing formaldehyde were made by Mr. Ogden, who with Mr. Jenkins did the other analytical work involved. This paper was prepared by Mr. Jenkins.

It needs to be emphasized here that, in regard to foods and food preservatives, each person is a law unto himself, and to avoid discomfort and ill health he must find out what he can eat and drink with satisfaction and what he should avoid. This becomes impossible if his food is liable to be loaded with antiseptics that he cannot at once recognize.

Even milk and oysters, which once we could safely assume to be "fresh," are at present not uncommonly preserved for days by adding to them either borax or formaldehyde.

It is just these foods too, which are frequently prescribed for persons of feeble digestion, and convalescents.

"Fresh" opened oysters, "guaranteed to be pure and as represented," are sold in the New Haven market, which contain more than 38 grains of borax to the pint.

While the opinions of medical men may differ widely regarding the effects on healthy adults of "moderate" doses of borax, we doubt if any reputable physician would assert that it is safe for a patient to subsist on food liable to contain such quantities of borax, during a long period of convalescence.

It is clear that, whether or not these preservatives, which have come into extensive use of late years, are proved to be harmless when administered in moderate amount to healthy adults, it is necessary in the interests of public health that the purchaser should be informed in all cases of their presence and proportions in the food products which he consumes, as he is informed when salt, vinegar, or wood-smoke are used.

The Food Law most justly provides that "an article shall be deemed adulterated" if it contain any antiseptic or preservative not evident and not known to the purchaser or consumer (Sec. 3, seventh). In Sec. 3 (c), an exception is made when a preservative "is added to a food because the same is required for the protection or preparation thereof as an article of commerce in a fit state for carriage or consumption," "and not fraudulently to conceal the inferior quality thereof."

This exception raises a point of law which would make necessary a court decision to establish the construction of the statute.

We believe the law without the exception just noted would be perfectly just, requiring that food products preserved with antiseptics not evident to smell or taste should be truly and distinctly labeled so as to inform the buyer of their presence.

In the Lancet—a leading English medical journal—of Jan. 2, 1897, appeared an article on the subject, containing communications from Sir Henry Thompson, Haliburton, Pavy, Brunton and other leading physiologists and physicians, who generally agree that, whatever difference of opinion there may be regarding the physiological effects of antiseptics, taken in small and continued doses, vendors of food products containing them should nevertheless be required by law to state, on labels or otherwise, the name of the preservative used and also the quantity used. At a recent meeting of the Incorporated Society of Medical Officers of Health (England) the following resolutions were adopted: (1) "That the Incorporated Society of Medical Officers of Health strongly disapproves of the practice of adding preservative chemicals to milk and other goods. (2) That if preservative chemicals are added to any food, a full disclosure as to the nature and amount thereof should be made to the purchaser."

In view of the fact that a considerable number of preservatives are now being extensively advertised in trade journals and elsewhere, many of them under proprietary names, and that antiseptics, as our reports show, are used in many kinds of food products, it becomes important to learn of what these preservatives are made and in what proportions they are used, if the directions which go with them are followed.

Accordingly, the Station has secured a considerable number of the advertised preservatives and these have been qualitatively—and as far as possible quantitatively—analyzed.

The results of this work appears in the following pages. We have considered it important also to cite the manufacturer's claims for each article and the directions for use. A comparison is given of the selling prices of these proprietary articles with the retail cost of the materials that compose them.

Preservatives for Milk and Cream.

9501 "Freezine. The only Scientific Milk and Cream Preserver." Manufactured by B. Heller & Co., Chicago, Ill.

"The advantage which we claim for Freezine over all other milk preservatives is the manner in which it affects the bacteria and preserves the milk. It is perfectly harmless and is not injurious to the human

system. Freezine does not in any way affect the composition, color or taste of milk. By the use of Freezine the milk or cream is not adulterated."

DIRECTIONS.

"Use about one tablespoonful of Freezine to every five gallon can of milk. This quantity will keep the milk sweet and in good condition for forty-eight hours without the use of ice. For cream increase the quantity one-half."

Prices.—Quart bottles.....each $1.00.
Half-gallon bottles 2.00
Gallons ..... 3.50.

This preparation is a liquid containing 5.19 per cent. of formaldehyde. Used at the rate indicated in the directions, each quart of milk would receive three quarters of a grain, or .05 grams.

The standard commercial preparation of formaldehyde, having the trade name "formaline" and containing over 35 per cent. of formaldehyde, cost at the time the sample of Freezine was bought, $1.40 per quart and contains six and one half times as much of the antiseptic agent as Freezine. At the present time, (Nov., 1899) the cost of formaldehyde is fifty cents per pound or about $1.10 per quart.

11638 Iceline. "A wonderful discovery. Keeps milk and cream sweet, without ice. Indispensable to dairymen, the shipper's friend."

DIRECTIONS.

"For Milk. Use about one-half to one tablespoonful of Iceline to every ten gallon can. Milk can be kept without the use of ice for 48 hours in a good sweet condition.

In case you desire to keep the milk sweet a longer time, give the milk another charge at the end of 36 hours."

PRICE LIST.

No discount. These prices are net.

Quart bottles .....each $1.00.
Half-gallon bottles ..... 2.00.
Gallon bottles ..... 3.50.

This preparation is made by Heller Chemical Co., Chicago, Ill., and was bought from Hatch & Co., 1 Desbrosses st., N. Y.

It contains 1.92 per cent. of formaldehyde, which is less than

half as much as was found in the sample of Freezine, made by B. Heller & Co., and it is directed to use only one tablespoonful to ten gallons of milk, whereas of the Freezine one tablespoonful is used with five gallons of milk.

Methods of Analysis. Ten grams of the formaldehyde solution are weighed into a flask and treated with an excess of standard ammonium hydrate solution.

The corked flask is shaken at intervals for several days. By this means the whole of the formaldehyde is converted into hexamethylamine.

The solution is then transferred to a weighed platinum dish, evaporated at a low heat—below 100° C.—nearly to dryness and the drying is finished in a desiccator. Allowance is made for the solid residue left by the formaldehyde solution on direct evaporation.

From the weight of hexamethylamine the corresponding formaldehyde is calculated.

Instead of weighing, the excess of standard ammonia may be distilled off and determined by titration and the percentage of formaldehyde calculated from the ammonia held in combination.

The former method gave 5.22 and 5.16 per cent. in sample 9501. The latter method, 5.15, 5.18, 5.20, 5.22, 5.22 per cent. Or five grams of the formaldehyde solution are digested with an excess of standard ammonia solution in a stoppered flask for 24 hours and the remaining excess of ammonia is determined with decinormal sulphuric acid, using one or two drops of a one per cent. solution of corallin or rosolic acid as an indicator.*

When free acid is present in the sample its quantity must be determined and taken into account.

By this method sample No. 9759 gave in four trials 1.94, 1.94, 1.97 and 2.10 per cent., an average of 1.99. By the two methods described above 1.79 and 2.12 per cent. were found.

9759. Special M Preservaline. Made by the Preservaline Mfg. Co., N. Y. City.

"The greatest, best and only scientific preservative for milk, cream, buttermilk, etc.

"Simply stir the Preservaline into the milk or cream. To keep milk 48 hours use 1 to 2 tablespoonfuls to every 40 quarts of milk. For a longer period use proportionally more. Double the quantity for cream."

The sample of this preservative was a solution containing 1.99 per cent. of formaldehyde.

If used according to directions, one quart of milk treated with it would contain from .01 to .02 gram (.15 to .30 grain) of formaldehyde.

*Zeitschr. für Untersuchung des Nahrungs and Genussmittel, May, 1895, p. 357.

9998 Rex Magnus Snow Flake Brand. Preservative for milk and butter. This and the following article, No. 11174, are made by the Humiston Co. of New Haven, and were bought by a Station agent from the company. Price 50 cents per single pound. The sample of this preparation contained 12.06 per cent. of salt and the equivalent of 78.15 per cent. of boric acid, of which about 35 per cent. is free and the rest is in the form of borax.

It is directed to use one-half ounce of the preservative to each gallon of milk, which amounts to 2.8 grams (42 grains) of boric acid—or the equivalent in borax—to one quart of milk.

11174. Rex Magnus, Pearl Brand or Cream Preservative.

"To each gallon of cream dissolve in a half tea cup full of hot (but not quite boiling) milk or cream a moderately heaped teaspoonful of the Pearl, then pour this into the cream (after it is cold), and thoroughly mix." "The above proportion is at the rate of one-half of an ounce of Powder to a gallon of cream. If it is desired to keep cream more than ten days use 50 per cent. more than above directed." Price 50 cents per single pound.

The sample of this brand contained 8.22 per cent. of salt and the equivalent of 95.72 per cent. of boric acid. The sum of these two ingredients is 103.94 per cent. This excess over 100 per cent. is accounted for by the fact that a portion of the boric acid is in form of borax and that the molecular weight of boric acid, H_3BO_3, is greater than that of the chemically equivalent anhydrous borax, ($Na_2B_4O_7$).

Cream treated with this material, according to the manufacturers' directions, will receive per quart 3.5 grams or 52 grains of boric acid—or the equivalent borax—and 0.29 gram or 4.4 grains of salt.

9758. M Preservaline for Preserving Milk and Cream. This, and the mixtures described below which bear the name Preservaline, are made by the Preservaline Mfg. Co., New York.

To keep milk for 36 hours use 1 ounce M Preservaline to 40 qts. of milk.
" " 48 " 2 " " " "
" " 60–72 " 3 " " " "
" " 4–6 days 5 " " " "
" cream for 48 hours use 3 " " to 10 gals. of cream.
" " 60–70 " 4 " " " "
" " 5 days 5 " " " "
" " longer 6–8 " " " "

The sample of M Preservaline consists of the equivalent of 97.81 per cent. of boric acid with two per cent. of other matters, chiefly soda.

When used according to directions, from .72 gram—or 10.8 grains—to five times that quantity of boric acid, would be added to each quart of milk and from 2.1 grams—or 32 grains—to twice that amount would be added to each quart of cream.

9761. B. B. Preservaline Especially for Creamery Use.

It "should not be used for milk or cream intended to be drank or to be made into ice cream."

To keep milk { 1 to 2 days / 2 " 3 " / 3 " 4 " / 4 " 5 " / 5 " 7 " } Use of BB Preservaline { 1 oz. / 2 " / 3 " / 4 " / 5 " } for each forty quarts of milk.

For cream add one ounce more.

The sample of B.B. Preservaline contained 32.56 per cent. of salt and for the rest consists of boric acid and borax equivalent to 65.42 per cent. of boric acid.

When used as directed, one quart of milk would receive from 7 grains (.47 gram) to five times that amount of boric acid or the equivalent borax.

9760. Preservaline Butter Powder.

"Makes churning easy, . . . removes all unpleasant flavor, saves time, labor and money. Produces finer butter." . . . "Removes all unpleasant taste caused by the cows eating turnips, weeds and other strong foods."

"For each gallon of cream, add to the cream in the churn, *and before churning,* from one-half to one tablespoonful of Preservaline Butter Powder dissolved in half a pint of lukewarm water."

This preparation is bicarbonate of soda.

9762. Cream Albuminoid. Made by the Preservaline Mfg. Co. Size B, costing 50 cents, contains 119 grams or about 4 ounces.

It is directed to dissolve the contents of this package in one quart of warm water, pour slowly into three gallons of *thin* cream, stirring for several minutes. After standing six or eight hours the mixture is to be stirred again and is then ready for immediate use. It "keeps the cream perfectly sweet for five to seven days."

The sample of this article contained 50.4 per cent. of boric acid, mixed with some proteid body—apparently gelatine.

The material itself contains 7.36 per cent. of nitrogen, or, excluding the boric acid, about 14.7 per cent. of nitrogen.

When used as directed there are added to one quart of cream 5 grams or 45 grains of boric acid.

Preservatives for Cider.

9756. Preservaline for Cider. Made by the Preservaline Mfg. Co. "A simple, harmless preparation free from taste, smell and color."

One ounce is enough to treat 20 gallons of cider. This preparation consists entirely of salicylic acid. Used at the rate indicated, one gallon of cider will contain 1.45 grams of salicylic acid. One quart will contain 0.36 gram or 5.4 grains.

No. 9901. Blue Seal Preservative. Bought by an agent of the Station from the Blue Seal Extract Co. of Boston, Mass. Labeled, "One Pound of Blue Seal Preservative especially adapted for"— Price $1.00 per pound.

For preserving cider it is directed to use 2 to 3 ounces of Blue Seal Preservative dissolved in a little hot water for a barrel of cider, but if it is desired to keep the cider over summer 5 to 6 ounces should be used.

The sample of this preservative contained 29.76 per cent. of boric acid, and for the rest consists of salicylic acid (70.24 per cent.).

Used as indicated, there would be added to each quart of cider *at least* 0.096 gram—1.4 grains—of boric acid and 0.225 gram—3.4 grains—of salicylic acid, and twice those amounts might be added.

9902. Forman's Cider Preservative. Made by C. D. Forman, Geneva, Ohio.

"It contains no salicylic acid or sulphate (*sic*) of lime as nearly all antiferments do. It can be added to cider whenever it suits the taste, and will preserve all its properties without further change, imparting a pleasant aroma, making it more palatable and inviting. It is perfectly harmless to the human system."

Two fluid ounces of the preservative are used for 45 gallons of cider.

The sample of this preservative was an alcoholic solution of beta naphtol; identified by its melting-point and characteristic reaction on boiling it in strong potash solution with chloroform.

11608. Preservite. Sold by Otto Hann & Bro., 268 Water St., New York City.

"The fresh juice as it runs from the press is dosed at the rate of 2½ to 3 ounces of our Preservite to the barrel of juice." . . . . . "When the cider has cleared itself, which it will do after some time, if treated with our Preservite, rack into clean barrels, and dose again with 1½ to 2 ounces of Preservite, bung up," etc.

This material contains over 96 per cent. of benzoate of soda. If treated as above directed each quart of finished cider would contain from 0.6 to 0.7 gram (9.0 to 10½ grains) of benzoate of soda.

Preservative for Wine.

9903. Forman's Preservative for Wine. Made by C. D. Forman, Geneva, Ohio. No directions accompanied the article.

The sample of this preservative was a solution containing 36.13 per cent. of formaldehyde.

Preservatives for Beer.

9778. Compressed Preserving Powders. For preserving beer. Large size for half barrels. Made by Wm. Zinsser & Co., 197 William St., N. Y. Bought from the manufacturer.

Each cubical "powder," the dose for a half barrel of beer, weighs about 16 grams, a little more than half an ounce. The sample examined contained 49.01 per cent. of salicylic acid, the only other ingredient detected being cane sugar. If used according to the manufacturers' directions, a half barrel of beer, 16½ gallons, would receive 7.9 grams of salicylic acid.

This is equivalent to about .12 gram—1.8 grains—per quart and half that quantity in a half litre glass or "stein."

9755. Patent Compressed Antacid Tablets for the Preserving of Lager Beers. Made by E. J. Beggs & Co., 101-103 Beekman St., N. Y. City.

These tablets are guaranteed "to be perfectly harmless, having neither taste nor smell, and will not affect the flavor, color or brilliancy of the beer but will keep it in sound condition and full body." Price 80 cents per pound in five pound lots.

The tablets weighed 4.7 to 4.8 grams, 1/6 of an ounce. One tablet is to be used to 1/8 barrel of beer.

The sample analyzed contained 44.76 per cent. of salt, and 27.12 per cent. of free salicylic acid, besides salicylate and carbonate of soda in quantities not ascertained.

Used at the rate indicated, one-eighth barrel, four gallons, would receive 1.29 grams of free salicylic acid and 2.13 grams of salt. One quart would contain .08 gram—1.2 grains—and a 1/2 litre glass, half that quantity.

9754. Emken's Preserving Cakes No. —. Made by New York Malt Roasting Co., Emken Chemical Co. Prop.

A small sample given to us by a brewer.

The sample contained 22.09 per cent. of free salicylic acid, cane sugar, and a considerable quantity of salicylate of soda, besides small quantities of magnesia and sulphates.

9779. A. Boake Roberts & Co.'s "K.M.S." in tablet form, sold by Charles Zoller, agent, New York.

"The best preservative for ale or beer." "24 tablets to the ounce. To be used in finished lager beer or ale at the rate of an eighth to a quarter of an ounce per American barrel."

The sample of this material contained:

Sulphate of potash	11.34
Bisulphite of soda	1.84
Bisulphite of potash	84.35
Other matters by difference	2.47
	100.00

The tablets contain 49.82 per cent. of sulphurous acid. If used as directed there would be added to each quart of beer .015 gram—or .23 grain of sulphurous acid and about half that amount to a half litre glass.

9753. K. M. S. Compressed Preserving Powders. Made by Rudolph Schneider of New York. A small sample sent by the manufacturer. The weight of the tablets and the directions for use were not learned. These tablets contained

Sulphate of soda (anhydrous)	16.61 per cent.
Bisulphite of soda	25.47
Sugar	48.00
Other matters, not separately determined, water of crystallization	9.92
	100.00

The sulphurous acid present amounts to 17.16 per cent.

Preservatives for Meats, Game and Fish.

9999. Rex Magnus, Viandine Brand. Preservative for Meat, Poultry, Fish and Game.

The printed "Uses" of the brand suggest injecting whole carcasses, dipping meats into a solution of it, wrapping roasts or steaks in cloths wet with such a solution. It can also be used for hardening and whitening tallow, etc.

The sample of this preservative contained 19.61 per cent. of salt, and borax and boric acid equivalent to 81.77 per cent. of boric acid.

11173. Rex Magnus. The Sportsman's Rex, for preserving trout, bass, delicate fish and game.

The directions are to sprinkle the preservative over the game, after drawing, inside and out, to wrap in cloths wet in a solution, or soak for some time in a solution of 1 pound of the preservative in 2 gallons of water.

"This brand has been prepared especially for sportsmen, and combines all the best qualities of several of our leading brands, and may be used for keeping milk, cream and all kinds of animal food."

This preservative has essentially the same composition as the one immediately preceding.

9997. Rex Magnus, The Ocean Wave Brand, for oysters, clams and sea food generally.

Oysters, clams and scallops are treated by stirring or mixing them with a solution of one pound of the preservative in two gallons of water to each twenty gallons of the fish food.

Fish are dredged with the preservative, one pound to one hundred pounds of fish or by soaking from two to six hours in the solution above described.

This brand contains 9.71 per cent. of common salt and 88.85 per cent. of boric acid, part of which is combined with soda in the form of borax.

11172. Rex Magnus Preservative for Sausage. It is directed to use one pound of this preparation to one hundred pounds of sausage meat.

The sample was a pasty mass from which liquid separated on standing.

It contained:

Sulphate of soda	2.00 per cent.
Normal sulphite of soda	6.55
Bicarbonate of soda	21.03
Salt	40.06
Other matters not determined, chiefly water	30.36
	100.00

The water expelled at a boiling heat was about 19.00 per cent. and there was also some unidentified organic matter. The sulphurous acid present amounted to 3.33 per cent.

9757. "A" Preservaline for Sausages, Tenderloins, Fresh Meats, Poultry, etc.

For sausage, white pudding, head cheese and the like, it is directed to sprinkle one-half pound over every 150 pounds of meat while being chopped.

One pound dusted over 500 pounds of fresh meat is sufficient to keep it.

Poultry, drawn and undrawn, are to be immersed for ten minutes in a solution made by dissolving one-quarter pound of this preservative in two gallons of water.

The sample of this preservative contains 32.00 per cent. of salt, and 68 per cent. of borax.

9780. Freeze-Em. Made by B. Heller & Co., Chicago., Ill.

The directions which accompany this article recommend its use on ribs and loins, dressed beef, pork sausage, etc. The directions for use on chopped beef may suffice to show the method and objects of its use. "To every 50 pounds of meat use one ounce of Freeze-Em. Sprinkle it over the meat before or while it is being chopped. When Freeze-Em is used, *all kinds of small pieces of beef* can be chopped up for Hamburger steak; it can be exposed for show on the counter and will remain *perfectly fresh* for many days." * * * "Another great advantage for the butcher is that all kinds of small pieces of meat can be used, and also that water can be worked into the meat."

The sample of this material contained:

Sulphate of soda	39.14
Normal sulphite of soda	57.48
Salt	2.18
Other matters by difference	1.20
	100.00

It contains 29.19 per cent. of sulphurous acid.

Summary.

An examination of the results given above shows that milk and cream preservatives now on the market depend for their antiseptic effects on salt, formaldehyde, borax and boric acid; and that if the directions given by the manufacturers are followed, a quart of milk will be dosed with from .01 to .05 gram (.15–.75 grain) of formaldehyde or with .47 to 3.6 grams (7.1–54.0 grains) of boric acid. Cream will receive from .94 to 5.0 grams (14.1–75 grains) of boric acid per quart.

Wine and cider preservatives have been found to contain formaldehyde, salicylic acid, boric acid, benzoic acid and beta-naphtol.

The cider, treated as directed by the manufacturers of the preservatives, may contain 0.36 to 0.9 gram (5.4–13.5 grains) of salicylic acid or 0.19 to 0.38 grams (2.9–5.8 grains) of borax or 0.6 to 0.7 gram (9.0–10.5 grains) of benzoate of soda per quart.

The beer preservatives contain salicylic acid and sulphurous acid in form of sulphites or bisulphites, and beer treated with them may contain from 0.04 to 0.12 gram (0.2–0.6 grain) of salicylic acid or 0.015 gram (0.23 grain) per half-litre glass.

Of sulphurous acid, preserved beer may contain .015 gram (0.23 grain) per half-litre glass.

Maas and Waldstein's Preserving Salts.

The Station bought six packages of "Preserving Salts" Nos. 1 to 6, made by Maas and Waldstein of New York, "Manufacturers of . . Preservatives, Antiferments, Food Colors, Flavors, Sweeteners, Extracts, in conformity with the laws and regulations of the Board of Health."

Each package contained one pound of "salts" and cost fifty cents. That each package bore a different number suggested

the probability of differences in chemical composition and in the uses to be made of their contents.

The directions for use were, however, the same on each package. "To 100 pounds, take 3–4 oz. dissolved in a half-pint of warm water."

All the samples contained between 29.05 and 33.16 per cent. of boric acid, free and combined, and between 7.26 and 7.59 per cent. of chlorine, equivalent to about 10¼ per cent. of salt.

ANALYSES OF BORAX.

By A. W. Ogden.

In view of the fact that at present borax is, if not a "food product," at least an ingredient of food and drink as found in our Connecticut market, a number of samples of "borax" were bought at drug stores and department stores in New Haven and analyzed with the following results:

Bought at Drug Stores.

9899. Squibb's Chemically Pure Borax. Made by E. R. Squibb & Sons, Brooklyn, N. Y. Bought of W. A. Spalding, New Haven.

11553. Bought of W. A. Spalding, New Haven.

11552. Bought of E. A. Gessner, New Haven.

11551. Bought of C. S. Leete & Co., New Haven.

Analyses.

	Squibb's 9899.	Spalding's 11553.	Gessner's 11552.	Leete & Co.'s 11551.
Anhydrous borax	69.87	70.69	55.39	53.11
Water at low red heat.....	29.75	29.28	44.29	46.69
Undetermined and loss.....	0.38	0.03	0.32	0.20
	100.00	100.00	100.00	100.00

These samples are all quite pure borax. two varieties of which are found in commerce that differ in the form of their crystals and in the proportions of their "water of crystallization."

The two samples 9899 and 11553 are essentially octahedral or pentahydrated borax, that contains 30.8 per cent. of water. The two others are mainly prismatic or decahydrated borax,

which when freshly made contains 47.1 per cent. of water, but which slowly loses water on exposure to dry air.

The samples cost 18 to 20 cents per pound. A comparison of these prices with those charged for proprietary antiseptics containing approximately the same quantities of boric acid indicates that either the expenses or the profits of the food preservative business must be large.

Bought at Department Stores and Groceries.

9900. Black Diamond Refined Powdered Borax. Put up by Archibald & Lewis, 193 Front St., New York City. Bought of The Gamble-Desmond Co., New Haven. Price 12 cents per pound.

11601. Cow Brand Best Refined Powdered Borax. Put up by Thos. F. Condon & Co., 15 Jay St., New York City. Sold by S. S. Adams, New Haven. Price 16 cents per pound.

11602. Rising Sun Borax. Refined Powdered Borax. Put up by James A. Blanchard, New York City. Sold by Ewen McIntyre & Co., New Haven. Price 10 cents per pound.

ANALYSES.

	9900	11601	11602
Borax	31.60	none	52.32*
Bicarbonate of soda	63.02	99.81	37.20
Other matters by difference	5.38	0.19	10.48
	100.00	100.00	100.00

As the analyses show, none of these samples of "borax" were what they were sold for; one contained no borax whatever, another contained nearly two-thirds of its weight of saleratus and another more than a third of its weight of saleratus.

ON TESTING FOOD PRODUCTS FOR BORIC ACID AND BORATES WITH TURMERIC PAPER.

BY E. H. JENKINS AND A. W. OGDEN.

In our experience this test is much more satisfactory than the flame test—depending on the greenish tinge given to an alcohol flame by boric ether—because it leaves a record of the reaction, independent of the observation of the one making the

*Equivalent to 36.2 per cent. of anhydrous borax.

test, at the moment when the green flame appears, and because it will show certainly the presence of smaller quantities of boric acid than the other.

Properly used, the turmeric test is perfectly reliable, but we have not found in text-books a full statement of the precautions to be observed.

When freshly prepared turmeric paper, made as directed in Fresenius' Qualitative Analysis, is moistened with an aqueous solution of chemically pure boric acid and dried at a gentle heat, the paper remains yellow with an orange reddish tinge, always slight, its density depending on the concentration of the solution. A solution of one gram of boric acid in 225cc. of water gave a faint color to turmeric paper moistened with it and then dried, which might easily be overlooked by an unpracticed person or ascribed to "traces" of boric acid. When, however, the dried paper is moistened with ammonia it becomes very dark brown, almost black, and quite different in appearance from turmeric paper made alkaline with ammonia.

When to the boric acid solution above described are added 8cc. of our standard HCl (1cc. of which contains .026 gram HCl) the reddish tinge imparted to turmeric is much more pronounced; with 16cc. and 24cc. of standard HCl the color becomes much deeper red, and the presence of boric acid is made unmistakably evident.

If to 20cc. of a boric acid solution such as that described above, 0.75cc. of strong hydrochloric acid (32 per cent. HCl) is added, the reddish brown color is more pronounced than with 24cc. of the standard HCl. Addition of still larger quantities of hydrochloric acid increases the density of the reaction color.

If to the boric acid solution (1 gram in 225cc. of water) 22cc. of strong hydrochloric acid are added, the reaction is perfectly satisfactory, although the turmeric paper on drying becomes brittle. There is no evidence that any large excess of hydrochloric acid interferes with the reaction.

It thus appears that free, chemically pure boric acid cannot certainly be distinguished by the reaction with turmeric from that in combination, since the presence of another acid is necessary to make the reaction quite decisive.

The impure boric acid of commerce, which contains some chlorin, either free or combined, gives a more pronounced reaction with turmeric paper.

Regarding the delicacy of this test, we find that a solution of one part of boric acid in 5000 of water gives an unmistakable reaction; one part in 10,000 gives a reaction which is not absolutely satisfactory, but quite decisive when the borate stain is made alkaline with ammonia.

One part in 20,000 gives a color to turmeric not distinguishable from that which is imparted by hydrochloric acid alone, but when made alkaline with ammonia there appears the bluish black color quite different from that produced on turmeric paper alone, or turmeric moistened with hydrochloric acid.

Borax solution, 1 gram in 225cc. of water, imparts to turmeric the usual color given by alkaline solutions. When standard HCl is added in amount exactly sufficient to decompose the borate,—determined by titration with lacmoid,—the resultant solution imparts to turmeric paper, after drying, a barely noticeable reddish tinge, which would easily be disregarded. But on moistening this paper with ammonia a dark brown, almost black color is produced, very different from that made by ammonia on turmeric paper alone. A further addition of 8cc. of our standard hydrochloric acid to the solution of boric acid just described, did not cause a very striking deepening of the color produced on turmeric. But the addition of strong hydrochloric acid—0.75cc. to 20cc. of the solution—gave a very strong and perfectly unmistakable reaction for boric acid.

It appears from these observations that free boric acid cannot readily be identified by the turmeric paper test if borates are present.

The material to be tested must in all cases be acidified with hydrochloric acid in order to ensure a satisfactory reaction with turmeric paper.

A considerable excess of hydrochloric acid must be added to the solution to be tested,—one-thirtieth by volume of concentrated HCl is not too much.

Perfectly decisive reactions need not be expected where less than one part of boric acid is present in 10,000 of water.

ANALYSES OF FORMALDEHYDE OR FORMALINE.

By A. W. Ogden.

This substance, which has decided antiseptic properties, in its pure state is a gas, but is used commercially in aqueous solution. In a previous article, pages 141 to 143 are given anaylses a number of proprietary articles, sold as food preservatives, the antiseptic properties of which are due to the formaldehyde in them.

Below are given four analyses of formaldehyde, sold under its true name, which serve to show the usual strength of the solution as it is found in market.

At present this article costs about $1.10 by the single quart and contains 35 per cent. or more of formaldehyde.

The proprietary solutions cost $1.00 per quart and contain from $^1/_7$ to $^1/_{17}$ as much formaldehyde.

11640. Formaldehyde. Merck. A one-pound bottle.

11642. Formaldehyde. Fries Bros., 92 Reade St., New York City. These two samples were bought of W. A. Spalding, New Haven.

11641. Formaldehyde. Merck. A one-quarter pound bottle bought of F. S. Calhoun & Co., New Haven.

11643. Formaldehyde. Sold by M. Cahm, New York City.

Analyses of Formaldehyde.

	Merck. 11640	Fries Bros. 11642	Merck. 11641	Cahm. 11643
Residue on evaporation at 100° C...	0.05	0.17	0.05	1.29
Specific gravity at 20° C.....	1.0601	1.0807	1.0769	1.0820
Percentage of formaldehyde.....	36.02	42.30	38.00	37.82

BANANA FLOUR.

This is stated to be prepared by drying the flesh of the fruit of the banana after removing the skins. The samples were submitted by Mr. A. E. G. Lubke, 92 West Houston St., New York.

	9889 Porto Rico Bananas.	9890 Florida Bananas.	9891 Honduras Bananas.
Water	13.43	5.34	10.33
Ash	2.24	2.90	2.55
Protein	3.50	2.81	2.87
Fiber	0.54	0.84	0.73
Nitrogen-free extract.....	79.82	87.45	87.02
Fat	0.47	0.66	0.50
	100.00	100.00	100.00

The samples are quite alike in composition, containing less than half as much protein as rice. Their nutritive value rests almost wholly in the materials which constitute the "nitrogen-free extract."

VINEGAR.

Three samples of vinegar, sent by purchasers for examination, contained the following percentages of solids and acids.

Station No.	12206	12207	9765
Solids	2.29	2.35	2.27
Acids, as acetic acid	3.90	3.90	4.10

MILK AND CREAM.

The Station has not drawn samples of market milk for examination during the past twelve months, but there have been sent in by dealers and buyers thirty-seven samples of milk, four of separator skim milk and two of cream, in all of which fat has been determined and in fifteen of the number the percentage of total solids also. The Station has no assurance that the samples were accurately drawn, but the milk was in most cases represented to be market milk from different dealers, mostly in New Haven.

The percentage of solids, in fifteen samples of milk, ranged from 11.53 to 15.10 and averaged 13.06.

The percentage of fat ranged from 2.2 to 7.1 per cent. and fourteen of the thirty-seven samples of milk had less than 3.5 per cent. of fat.

Three samples of cream contained respectively 18.25, 20.25 and 21.75 per cent. of butter fat.

Four samples of skim milk, from a centifugal separator, contained the following percentages of fat: 0.08, 0.23, 0.03 and 0.08.

FOOD PRODUCTS EXAMINED FOR THE DAIRY COMMISSIONER IN THE TWELVE MONTHS ENDING JULY 31, 1899

Butter.

Two samples of suspected butter were examined and found to be oleomargarine.

Molasses.

Two hundred and thirteen samples of molasses and syrups have been examined in the year ending July 31, 1899.

Method of Examination. 13.024 grains (one-half the normal weight) of molasses were dissolved in about 80 cc. of water, 3 cc. of basic lead acetate were added, the volume was made up to 100 cc. and the whole was thoroughly mixed and passed through a dry filter. The rotation of the clear and nearly colorless filtrate was determined, in a 200 mm. tube, with a Schmidt and Haensch half shade double compensation polariscope. The reading, doubled, gave the sugar degrees or per cent. No correction was attempted for the volume of the lead precipitate.

To 50 cc. of the filtrate referred to above were added 5 cc. conc. C. P. hydrochloric acid, and, after thorough mixing, the flask containing the solution was placed in a cold water bath, which was then quickly heated to 68° C. After standing at that temperature for 10 minutes, the contents of the flask were quickly cooled and the solution, filtered from lead chloride when necessary, was examined in a 220 mm. tube, provided with a water jacket. The temperature was noted with the reading. This reading, doubled, gave the sugar degrees after inversion.

Water heated to 86° C., was then passed through the jacket and a third reading made at that temperature.

The rotatory power of dextrose is not greatly affected by the temperature, but that of levulose diminishes as the temperature rises, so that invert sugar becomes practically inactive at about 86°.

Results of Examination. Of the 213 samples examined for the Dairy Commissioner 44 were found to be adulterated with glucose syrup. The percentage of adulterated samples is 20.7. In 1898 the percentage was 20.1 and in 1897, 32.8.

Honey.

In two samples of strained honey, in bottles, submitted by the Dairy Commissioner, no evidence of adulteration was found.

Vinegar.

Of the forty-five samples examined for the Dairy Commissioner, the larger number were sold as cider vinegar. The total solids in these samples ranged from 1.20 to 3.61 per cent. and the acidity, reckoned as acetic acid, from 2.73 to 5.74 per cent.

Coffee.

The sixty-one samples of coffee collected by the Dairy Commissioner are included in those reported on pages 106 to 111.

COMMERCIAL FEEDING STUFFS.*

In accordance with the requirements of the law regarding Commercial Feeding Stuffs, which is given on pages 96 and 97 of this Report, the Station has analyzed two hundred and forty-one samples of feeds during the last twelve months, and has already published the results of this work in Bulletin 130. In order, however, that the present Report shall contain a full account of the Station work, as required by law, the account of the work on feeding stuffs is also made a part of this Report.

USE OF COMMERCIAL FEEDING STUFFS.

Commercial Feeding Stuffs are bought to supply certain deficiencies in the cattle food which is raised upon the farm.

Hay, corn fodder, ensilage and stover with corn meal, raised at home, form the basis and make up the bulk of the cattle food and supply all of the coarse feed and of the starch, sugar and fat which are required. They are, however, deficient in digestible protein.†

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*The microscopic work referred to in this paper was wholly done by A. L. Winton. The chemical analyses were mostly made by A. W. Ogden, W. L. Mitchell and Clifford Langley. The discussion of the results is by E. H. Jenkins.

†Protein is the name now commonly given to a class of substances (also termed "proteids" or "albuminoids") of which the muscles, brain, nerves, tendons and all other working or necessary organs and parts of the animal body largely and essentially consist. Protein contains from 14 to 19 per cent. of nitrogen.

The white of eggs, the fiber of lean beef, the clot of blood, the curd of milk and the gluten of wheat are familiar examples of protein. Other similar matters are found in all animals and in all plants.

The animal cannot grow or long exist without constantly renewed supplies of protein in its food. The animal itself is totally unable to create protein. Only plants can originate protein, which they do from the plant-food of air, soil and fertilizers or manures. Animals can produce or create blood-protein, brain-protein, flesh-protein and milk-protein, but only by appropriating and transforming or making over the similar but different protein of plants.

Other needful food-substances or nutrients, such as cellulose (woody fiber), starch, sugars, gums, pentosans (that yield gums and jellies), acids and fats or fat oils, contain no nitrogen and collectively are commonly termed "non-nitrogenous matters"; we shall usually designate them as "non-protein."

Few farmers are now raising as much protein, in concentrated form, as is required to bring cattle up to and maintain them in the most profitable condition. Two chief defects in our present farm management are that little care is given to the raising of crops rich in protein and that, as a rule, insufficient protein goes into the food of our cattle.

If the quantity of digestible protein in the food is too small, the animals produce less beef or milk than they easily would with a proper supply of protein. Furthermore, when protein is deficient, the other (non-nitrogenous) matters of the ration are in excess of the animal's capacity for assimilating them and are therefore to some extent wasted. The latter (starch, sugar, etc.) in part pass through the body, incompletely digested and—unlike the protein—give little value to the manure.

To meet and overcome these defects in home-grown cattle food, dairymen and keepers of live-stock buy commercial feeds; they should buy them *chiefly* with the purpose of getting digestible protein in cheap and concentrated forms.

A feed rich in digestible protein is, when properly used, "milk-producing"; a feed rather poor in protein, however highly endorsed, cannot prove permanently satisfactory, or be a "milk producer" in any way superior to home-raised coarse feed and corn meal.

Every farm on which cattle are kept for profit should yield all the *hay, corn fodder, corn ensilage, corn stover* and *corn meal* which the live stock on it need to eat.

One hundred pounds of each of the feeds just named contain, on the average, the following quantities of *digestible nutrients* or elements of food:

TABLE I.—QUANTITIES OF DIGESTIBLE NUTRIENTS IN ONE HUNDRED POUNDS OF THE FEEDS NAMED.

(From Armsby, Penn. Ag'l Ex. Sta. Rep., 1897-98, p. 45.)

	Red Top Hay.	Corn Fodder Field-cured.	Corn Stover Field-cured.	Corn Ensilage.	Corn Meal.
Total dry matter.....	91.1	57.8	59.9	27.9	85.0
Digestible protein.....	4.8	2.5	2.0	1.1	5.5
Digestible non-protein*..	49.2	36.1	34.8	18.2	71.1
Ratio of digestible protein to digestible non-protein, ("Nutritive Ratio").....1:10.3		1:14.4	1:17.4	1:16.5	1:12.9

*Since fat is believed to have about 2¼ times the nutritive effect of starch and similar non-nitrogenous matters, the digestible fat is, in these calculations, reduced to its "starch equivalent" by multiplying by 2¼.

Observation and careful experiment have shown that milk cows need, per day and per 1,000 pounds of live weight, about 24 pounds of dry matter including 2 to 2½ pounds of digestible protein and from 13½ to 15 pounds of digestible non-protein (sugar, starch, fat, etc.), and that the quantity of digestible non-protein in this *standard ration* should be between five and one-half and seven times as great as the digestible protein.

Now a glance at the preceding table shows that no one of these staple farm products, nor any combination of them, can furnish the most profitable cattle food.

All of them have from ten to seventeen times as much non-protein as protein, and hence a properly balanced ration cannot be made up from them without adding some feed much richer in protein and poorer in non-protein than any one of them.

Feeds rich in protein are what the stock owner most commonly needs to buy, and they are the ones the purchase of which is most likely to be profitable. All feeds contain non-nitrogenous matters, starch, sugar, etc., but those best worth buying *should* have a considerably larger proportion of protein than any which are commonly raised on the farm.

In the preparation of vegetable foods for human consumption and in the manufacture of cotton seed and linseed oils, certain by-products are produced, unfit for human food, but rich in protein and valuable as feed for horses and cattle. There are also certain other products which are of very little value as cattle food because of the small amount of protein in them, or they are uneconomical to buy, because they contain no larger *proportion* of protein than corn meal which is raised on the farm.

Both kinds of by-products are now offered for sale, frequently without an analysis or other statement to inform the buyer as to the real nature or value of what he is purchasing, and in consequence a good deal of money is spent for cattle feeds uneconomically.

THE AVERAGE COMPOSITION OF COMMERCIAL FEEDING STUFFS.

In order to show the average composition of the various brands of feeding stuffs which are at present offered in the New England market as well as the range or variation of composition, Table I has been prepared. This includes the analyses, more than 1,600 in number, which have been published since May, 1898, in Bulletins 44, 47, 48 and 51 of the Maine Station, in Bulletins 53 and 56 of the Massachusetts Station and in Table II pages 178 to 195.

Table I gives the number of analyses on which each average is based, the average percentages of protein and fat, and the highest and lowest percentages of each of these ingredients found in any single analysis.

In a few instances, where the figures found in a single analysis were such as to make it quite certain that the sample was adulterated or was not of the kind represented, they have been excluded from the average and from the minimum figures.

In some cases, not only is the lowest percentage of protein and fat given, but also the one or two percentages which stand next; for sometimes, among a large number of analyses, there is a single result very much lower than any other, which marks an extremely exceptional case.

ANALYSES OF THE COMMERCIAL FEEDS FOUND IN THE CONNECTICUT MARKET IN 1899.

During the year ending Nov. 1st, 1899, the Station has drawn two hundred and forty-one samples of commercial feeding stuffs and in conformity with law gives the results of their examination in Table II, pages 178 to 195 of this Report.

The law prescribes that the analysis "shall include determinations of crude fat and crude protein and such other determinations as may at any time be deemed advisable."

The analyses here reported include determinations of moisture, ash, fiber and nitrogen-free extract, in addition to protein and fat. Many of the feeds have also been examined carefully with the microscope to determine what materials if any were present other than those named in the brand or label.

These feeds are classified as follows and are discussed in following pages in the order here given (see page 165):

TABLE I.—AVERAGE COMPOSITION OF FEEDS AS DETERMINED BY ANALYSES MADE IN THE NEW ENGLAND STATES, LATER THAN MAY, 1898, AND COMPILED BY THE CONN. AGRICULTURAL STATION, NEW HAVEN, CONN., JAN. 1, 1900.

	No. of Analyses.	Protein.			Fat.		
		Average.	Highest.	Lowest.	Average.	Highest.	Lowest.
Cotton Seed Meal, hulled, all analyses	205	45.4	52.6	40.3	11.2	17.0	6.5
			51.9	41.2			
			51.2	41.7			
" " Southern Cotton Oil Co's	33	45.3	48.3	41.4	10.7	13.1	9.1
" " Amer. Cotton Oil Co's	46	45.5	50.8	40.3	11.4	12.2	8.8
" " Sea Island, unhulled	8	26.8	36.1	24.4	7.0	8.2	5.8
Linseed Meal, New Process	31	38.2	42.2	34.6	2.4	3.5	1.8
				36.8			2.1
" " " Amer. Linseed Co's	23	38.5	42.2	34.6	2.2	3.5	1.9
				36.8			2.1
" " Old Process, all analyses	25	35.7	38.9	31.8	7.2	9.6	2.7
				31.8			4.7
							6.3
" " " Nat'l Linseed Oil Co's	11	37.2	38.9	35.1	6.7	9.6	2.7
				36.1			5.8
							5.9
Wheat Bran, all analyses	120	15.8	17.9	13.6	4.7	5.6	3.5
			17.8	13.9			3.9
" " from Winter Wheat	45	15.5	17.8	13.6	4.4	5.6	3.5
			17.4	13.9			3.9
			17.3				
" " from Spring Wheat	53	16.1	17.5	15.1	4.9	5.6	4.4
			17.5	15.1		5.3	4.5
Wheat Middlings, all analyses	135	17.0	22.2	12.4	5.0	7.1	2.6
			21.9	13.1		7.1	2.6
" " from Winter Wheat	20	16.0	17.9	12.4	4.8	5.1	4.4
			17.8	13.1		5.0	4.8
" " Spring Wheat	60	18.8	22.2	16.0	5.2	7.1	3.3
			21.9	16.5		5.9	3.4
			21.5	16.6			3.7
Mixed Wheat Feed, all analyses	219	16.6	20.0	14.0	4.7	5.8	3.6
" " from Winter Wheat	88	16.2	18.5	13.8	4.5	5.4	3.6
			18.1	14.0		5.3	3.9
				14.5		5.2	3.9
" " from Spring Wheat	60	17.3	19.8	15.6	4.9	5.5	3.8
			18.9	15.8		5.4	4.3
				16.2			4.4
Red Dog Flour	9	19.3	21.2	16.5	4.4	5.3	3.4
Corn Meal	17	9.5	10.8	8.6	4.0	4.7	2.7
				8.9			3.1
				9.0			
Atlantic Gluten Meal, Atlantic Starch Works	2	48.9	49.1	48.8	7.9	2.0	1.7
Chicago Gluten Meal, Glucose Sugar Rfg. Co.	76	36.7	41.3	31.7	2.7	7.6	1.4
							1.6
							1.7

TABLE I.—AVERAGE COMPOSITION OF FEEDS AS DETERMINED BY ANALYSES MADE IN THE NEW ENGLAND STATES, LATER THAN MAY, 1898, AND COMPILED BY THE CONN. AGRICULTURAL STATION, NEW HAVEN, CONN., JAN. 1, 1900—*Continued.*

	No. of Analyses.	Protein.			Fat.		
		Average.	Highest.	Lowest.	Average.	Highest.	Lowest.
Cream Gluten, Chas. Pope Glucose Co.	40	34.1	41.3	30.1	3.2	6.1	1.6
			41.2	30.9		5.4	1.7
			38.9	31.0		4.9	1.8
Buffalo Gluten Feed	34	27.5	29.6	25.3	3.1	4.7	2.3
			29.5	26.3		4.3	2.3
			29.0				2.5
Diamond Gluten	30	23.6	30.1	20.3	3.6	5.0	2.3
			27.0			4.4	2.8
			25.8				2.8
Golden Gluten	15	27.0	29 6	23.6	3.0	4,0	2.0
						3.4	2.1
Hominy Chops, White Meal	20	11.2	12.0	10.3	7.8	9.7	4.0
			11.8	10.7		9.5	5.1
			11.6	10.9		9.3	5.8
Ground Oats	3	11.0	13.7	8.3	4.0	5.0	3.2
Provender	22	9.4	10.8	7.9	3.8	5.4	2.9
			10.6	8.2		4.8	3.1
			10.5	8.3		4.5	3.2
Corn and Oat Feed, Victor Am. Cereal Co.	26	9.2	11.3	9.5	3.9	5.1	2.9
" " Various brands	17	9.5	12.3	8.2	3.7	7.1	2.7
Oat Feed, Crescent	3	7.9	8.6	7.3	3.3	3.7	3.0
" Quaker, Am. Cereal Co.*	36	10.3	12.8	7.4	3.4	4.3	2.6
			12.4	7.8		4.3	2.7
			11.7	7.9		4.1	2.8
" Various brands	16	9.3	12.6	4.4	4.2	8.8	1.5
Oatena	1	9.4	----	----	4.3	----	----
Corn, Oats and Barley Feed, American Cereal Co.	6	11.9	12.8	11.3	4.5	5.4	4.0
H. O. Co.'s Dairy Feed	20	19.0	21.2	15.5	4.4	5.4	3.7
			20.9	16.5		5.0	3.8
			20.6	17.1			3.8
" " Horse Feed	18	12.4	13.8	11.0	4.2	4.8	3.6
			13.7	11.1		4.5	3.8
			13.3	11.7		4.4	3.8
" " Poultry Feed	14	17.5	19.5	15.0	5.5	6.0	4.7
			18.3	16 7		5.1	4.8
			17.8	17.1		5.9	4.8
Am. Cereal Co.'s Quaker Dairy Feed	5	12.8	14.1	11.3	3.9	4.4	3.5
" " Am. Poultry Food	8	14.2	15.5	13.4	5.4	5.9	4.8
Blatchford's Calf Meal	3	27.7	33.4	24.8	4.8	5.2	4.4
Rye Bran	4	14.6	14.8	14.3	2.8	2.9	2.7
King Gluten, Des Moines Mill	39	32.9	37.1	26.4	15.4	19.8	11.7
				29 9			
" " Indianapolis Mill	10	34.6	37.3	32.1	4.8	6.9	2.7

* The American Cereal Co.'s Quaker Oat Feed is no longer made, being superseded by Dairy Quaker Feed.

	No. of Samples Examined.
Cotton Seed Meal	10
Linseed or Flax-seed Meal	12
Ground Wheat	1
Bran, from Winter Wheat	7
Spring Wheat	9
Unclassified	5
Middlings, from Winter Wheat	1
Spring Wheat	6
Unclassified	17
Mixed (Wheat) Feed, from Winter Wheat	15
Spring Wheat	7
Unclassified	25
Corn Meal	9
Gluten, Gluten Meal, Gluten Feed:	
Atlantic Gluten	2
Chicago Gluten	5
Pope Gluten	4
King Gluten	2
Buffalo Gluten Feed	6
Diamond Gluten	2
National Starch Co.'s Gluten Feed	2
Miscellaneous	6
Hominy Chops	8
Ground Oats	2
Provender	13
Corn and Oat Feed	6
Oat Feeds	14
Oat Chaff	1
Corn, Oats and Barley	2
Rye Bran and Rye Feed	5
Malt Hulls	1
Starch Feeds	2
Champion Bell Fodder	1
H. O. Dairy Feed	6
Horse Feed	9
Poultry Feed	3
American Cereal Co.'s Quaker Dairy Feed	5
Poultry Feed	1
Blatchford's Calf Meal	1
Pioneer Clover Meal	1
Carob Beans	1
Pods	1
Beans and Pods	1
Baum's Horse and Stock Food	1
Bowker's Animal Meal	1
Lederer's Chicken Food	1
Beef Scraps	1
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Cotton Seed Meal.

After removing the cotton fiber by machinery as far as possible, the black outer covering or "hull" of the cotton seed is broken off by machinery and separated from the yellow kernels or meats. These kernels are cooked and while still hot are subjected to hydraulic pressure, which removes a part of the oil

and leaves the residue, "cotton seed cake," in very hard plates or sheets which can be cut with a saw like boards. These cakes when broken and finely ground make the "cotton seed meal" of the feed market: the most concentrated cattle food which is in general use.

In the ten samples examined, the analyses of which appear in the table, page 178, no admixture of foreign matters was found and all were of good quality as regards chemical composition, the percentage of protein ranging from 49.38 to 44.20 and of fat from 12.96 to 8.55.

The average of many recent analyses of cotton seed meal gives 45.4 per cent. of protein and 11.2 per cent. of fat, while these ten samples contain on the average 46.4 per cent. of protein and 10.4 per cent. of fat.

Undecorticated cotton seed meal, full of black hulls and with only 30 per cent. of protein, and cotton seed meal adulterated with rice refuse, have been found in this State in times past. At present much more cotton seed meal is used in Connecticut as a fertilizer,—chiefly for tobacco,—than as a feed, and the frequent publication of analyses made in the interest of tobacco growers has driven out the inferior grades of cotton seed meal.

Guarantees.

Three of the samples were from lots having a guaranteed analysis. The guaranteed and actual percentages of protein and fat in these cases were as follows:

		Protein.		Fat.	
		Found.	Guaranteed.	Found.	Guaranteed.
12125	Dixie Bran.....	45.9	43–48	9.0	10–14
12126	Chapin & Co.....	44.2	43	12.8	9
12132	J. E. Soper & Co.	44.7	43	9.6	9

In neither case is there any deficiency of protein. In one case there is a per cent. less of fat than is guaranteed, but the protein in this sample is nearly three per cent. above the guarantee.

LINSEED MEAL.

For removing the oil from flaxseed or linseed two methods are employed. Under the "old process" the crushed seed, while warm, is subjected to hydraulic pressure which squeezes out much of the oil. The residue is in the form of hard cakes which when broken and ground make the "old process linseed

meal." Under the "new process" the oil is removed from the crushed seed by a solvent, like benzine, which is afterwards fully removed from the residue by steaming. The extracted residue is "new process" meal.

Practically all the flax seed on the feed market has been treated by one or other of these processes. New process linseed meal contains on the average two and a half per cent. more of protein and four and three-quarters per cent. less of oil or "fat" than old process meal.

Of the twelve samples examined none were found in any way adulterated.

Samples 12156 and 12074 (though labeled "old process") and samples 12088 and 11567 are new process meals, as is indicated by the low percentage of fat.

Samples 11385, 11381 and 11585 are inferior, because of their low percentages of protein.

Wheat Feeds.

These are by-products in the manufacture of wheat flour. Several different processes of milling are in common use yielding by-products which are not entirely alike in composition. There are also differences in composition between the products from winter wheat and those from spring wheat.

Wheat Bran consists of the outer layers of the wheat berry which are dark in color and do not easily pulverize.

Wheat Middlings,—as found in the feed market—, consist of inner layers of the covering of the berry, which are lighter in color and more easily pulverized than bran, and of other parts from which fine white flour cannot be made. Red Dog Flour is the poorest grade of flour, off color and often sold as a cattle food.

It is also used for paste and in making "pancake leather"—composed of leather scraps and flour paste, compacted by hydraulic pressure, stated to be made up into soles for children's shoes.

Many mills do not sell bran and middlings separately, but run them together and sell the product as "Mixed Feed."

Red Dog Flour is also sometimes run in to the Mixed Feed.

In the compilation on page 163 as well as in the tabulation of the wheat products analyzed at this Station, which appears on pages 178 to 185, the product from the following mills is classed as from winter wheat:

Acme Milling Co., Indianapolis, Ind.
American Cereal Co., Chicago.
Blish Milling Co., Seymour, Ind.
Cole, H. C., Milling Co., Chester, Ills.
Eldred Mill Co., Jackson, Mich.
Evans, Geo. F., Hoosier Mills, Indianapolis, Ind.
Hannibal Milling Co., Hannibal, Mo.
Harter, Isaac, & Co., Galena, O.
Holly Milling Co.
Hunter Bros., St. Louis.
Jenks, J., & Co., Sand Beach, Mich.
Kehlor Bros., St. Louis, Mo.
Lawrenceburg Roller Mills Co. "Snowflake," Lawrenceburg, Ind.
Lexington Roller Mill Co., Lexington, Ky.
Maumee Valley Milling Co., Defiance, Ohio.
McDaniel & Pitman Co., Franklin, Ind.
Meyer, J. T. & Co., Clinton, Mo.
Miles & Son, Frankfort, Ky.
Model Roller Mills, Nashville, Tenn.
Moore, R. P., Milling Co., Princeton, Ind.
Rex Milling Co., Kansas City, Mo.
Saginaw Milling Co., Saginaw, Mich.
Stock, F. W., Hillsdale, Mich.
Stott's Flour Mills. Detroit, Mich.
Taylor Bros. Milling Co., Quincy, Ill.
Valley City Milling Co., Grand Rapids, Mich.
Voigt Milling Co., Grand Rapids, Mich.
Walsh De Roo Milling Co., Holland, Mich.

The wheat products from the following mills are classed as from spring wheat:

Anchor Milling Co., Superior, Wis.
Bay State Milling Co., Winona, Wis.
Daisy Roller Mill Co., Milwaukee, Wis.
Duluth Imperial Mill Co., Duluth.
Freeman Milling Co., Superior, Wis.
Grafton Roller Mills, Grafton, N. D.
Lake Superior Mills, Superior, Wis.
Listman, Wm., Milling Co., Superior, Wis.
Minkota Milling Co., Superior, Wis.
Moseley & Motley Milling Co., Rochester, N. Y.
North Dakota Milling Association, No. Dakota.
North Western Consolidated Milling Co., Minneapolis.
Pillsbury-Washburn Co., Minneapolis.
Russell & Miller Milling Co., Superior, Wis.
Star & Crescent Milling Co., Chicago.
Washburn-Crosby Co., Minneapolis.
Whitney & Wilson, Rochester, N. Y.

At present, winter wheat bran is worth on the average about seventy-five cents per ton more than spring bran, although the latter as a rule contains a half per cent. more of protein and a per cent. more of fat than the former.

But white winter wheat bran (from Michigan or Canada) sells for from seventy-five cents to a dollar per ton more than the common red wheat.

Ground Wheat.

A single sample was analyzed and found free from admixture with foreign matters.

Wheat Bran.

Eight samples of winter wheat bran and nine of spring wheat bran were analyzed. Regarding four others it is not known which kind of wheat they represent. In none of them was there any evidence of adulteration.

All the winter brans contained more than the average percentage amounts of protein. In several of the spring brans the percentage of protein was rather low.

Occasionally "cheap" bran is offered for several dollars a ton below the regular market rates. Such "bargains" are to be looked upon with great suspicion. In a "cheap" bran referred to us from another State, microscopic examination showed the presence of finely ground corn cobs.

Middlings.

Six samples of spring wheat middlings, one of winter wheat middlings and seventeen regarding which it is not known whether they represent winter or spring wheat, were examined.

Of the unclassified middlings, Nos. 12159, 12144 and 14012 have such low percentages of protein and the two former such low percentages of fat as well, that unless they were sold under a guarantee which corresponded with their actual composition, or at a reduced price, the buyer would be justified in objecting to them.

Some sorts of middlings closely resemble bran, while others are very fine and starchy, having much the look and composition of wheat flour.

They also show a wide range of composition. Thus one of the samples contained over twenty per cent. of protein, while another contained less than thirteen. The price is practically the same, but the one is a valuable feed and the other is uneconomical to buy even at a much lower price.

As a rule spring wheat middlings contain two and one-half per cent. more of protein and a half of one per cent. more of fat than winter wheat middlings.

Mixed (Wheat) Feed.

Nineteen analyses of feed from winter wheat are given in the table page 182, nine of feed from spring wheat and twenty of feed in which the kind of wheat is not specified.

Of the winter wheat feeds all are of good quality, a single one, 12802, being deficient in fat.

Of the spring wheat feeds two, 12105 and 12803, are rather low in protein, but all appear to be genuine wheat products free from adulteration.

The same is true of the twenty-five samples of feed in which the kind of wheat is not specified.

Mixed feed from spring wheat contains as a rule about eight-tenths per cent. more of protein and three-tenths per cent. more of fat than that from winter wheat.

Corn Meal.

In the table on pages 184 to 187 are given nine analyses of this article which show the usual range of composition. They were all free from admixture with cobs or other adulterant.

We have already called attention to the fact that while corn meal *raised on the farm* may be used in a ration, it has to be supplemented by more nitrogenous, more "concentrated" feeds. But it is poor economy to buy corn meal, for feeding milch cows, at a cost of $17 to $19 per ton, when wheat feeds and gluten feeds, which are much richer in protein and much more fit to balance the ration, can be bought at just about the same price as corn meal.

Old crop corn meal contains from ten to fourteen per cent. of moisture. New crop meal may contain twenty per cent. or more of moisture, with correspondingly lower percentages of other ingredients.

Gluten, Gluten Meal, Gluten Feed.

These are by-products obtained chiefly in the manufacture of glucose and corn (or wheat) starch.

The process used for separating these by-products by the Glucose Sugar Refining Co. of Chicago, at all its factories,—Chicago, Rockford and Peoria, Ill., Davenport and Marshall-

town, Iowa, may be outlined as follows: The corn, after soaking for twelve to twenty-four hours in warm water containing three-tenths of one per cent. of sulphurous acid, is ground with water which carries off the mill product in suspension. By rightly adjusting the amount of water and corn, the chits or germs separated by the grinding float on the surface and are skimmed off. A large percentage of oil may be removed from these chits by pressure and the germ cake may be sold by itself or in mixture as a cattle food.

After separating the germs, and straining to remove part of the starch, the residue is ground once more and again passed over sieves which retain the hull or husk of the kernel. This is dried, ground and sold as "corn chop." The gluten or nitrogenous matter of the kernel and the starch suspended in water which have passed together through the sieves are next run with water over settling tables, where the starch, by reason of its greater specific gravity, settles first out of the stream of water and is thus separated from the gluten. The gluten is dried, ground and sold as cattle food while the starch alone is used in the factory. It will be seen from this description that no chemical is used in this process, except a very small quantity of sulphurous acid which must be completely washed out with the large quantities of wash water used.

We are advised that the methods employed by the Charles Pope Glucose Co. and by the National Starch Manufacturing Co. in extracting these feeds are essentially like those used by the Glucose Sugar Refining Co.

On pages 186 to 189 are given the analyses of gluten meal and gluten feed which have been lately made at this Station.

Atlantic Gluten Meal, made by the Atlantic Starch Works, Westport, Conn., is derived from wheat, being a by-product in the manufacture of wheat starch, and contains a larger percentage of protein than any other feed in our markets.

The manufacturers guarantee 38-40 per cent. of protein and the two samples analyzed contained respectively 48.8 and 49.1 per cent. with 1.70 and 2.04 per cent. of fat.

The manufacturers of *Chicago Gluten Meal* state that it contains 36 per cent. of protein and 3.0 per cent. of fat, but we are informed that this statement refers to the *dry matter* of the meal.

The lowest percentage of protein found *in the dry matter* of any sample was 38.8 and the lowest percentage of fat 1.95. But the sample with this low percentage of fat contained *in the dry matter* 43.8 per cent. of protein, nearly seven per cent. more of protein than the guarantee, and for feeding purposes is of course worth to the buyer more than gluten meal which contains the exact guaranteed amounts of protein and fat. The five samples of Chicago gluten meal contain on the average 12.32 per cent. of water, 37.17 of protein and 2.5 of fat: or calculated on the dry matter 42.2 per cent. of protein and 2.85 of fat.

Cream Gluten Meal, made by the Chas. Pope Glucose Co. of Chicago, is stated by the manufacturers to contain 34.12 per cent. of protein and 3.20 of fat. In the four samples examined protein ranges from 32.12 to 35.37 per cent. and fat from 1.70 to 3.78 per cent., while the average figures were 33.91 per cent. of protein and 2.44 per cent. of fat; nearly two per cent. more of protein and a half per cent. less of fat than the guarantee.

King Gluten is made by the National Starch Manufacturing Co. at two factories, and the product of these factories is quite unlike in composition.

As appears in the table on page 186, the product of the Indianapolis mill contains about 34.6 per cent. of protein and 4.8 per cent. of fat, while that of the Des Moines mill contains 32.9 per cent. protein and 15.3 per cent. fat. Buyers should find out, before purchasing, which product they are getting, for the one brand covers two very different feeds.

Gluten Feed. The gluten feed now made by the Glucose Sugar Refining Co. at its several factories is stated to be uniform in composition. The output of the Davenport factory is sold under the brand "Davenport Gluten Feed." That of the Marshalltown factory is branded "Marshalltown Gluten Feed"; that of the Peoria factory is branded "Buffalo Gluten Feed" and that of the Rockford factory as "Rockford Diamond Gluten Feed." "Golden Gluten Feed" is no longer sent out under that brand.

All these brands, as made at the present time, are stated by the manufacturer to contain 27.0 per cent. of protein and three per cent. of fat *in the dry matter.*

The six samples of *Buffalo Gluten Feed* contained on the average (9.63 per cent. of water) 30.2 per cent. protein and 3.6 per cent. of fat. The protein in the dry matter of all was well above 27 per cent.

In one case the fat was below 3 per cent.

The percentages of protein in the three samples of "Rockford" gluten feed and the two of "Diamond" gluten feed ranged from 22.81 to 30.12. It is possible that some of these samples represented feed manufactured before the consolidation of these factories and the introduction of uniform methods of preparation.

The gluten feed made by the National Starch Mfg. Co. apparently has no guarantee.

Hominy Chops.

Also called hominy feed, white meal, Baltimore meal, is a by-product from the manufacture of hominy. The eight samples analyzed were of average composition and no evidence of adulterants was found in them.

Ground Oats.

Of the two samples examined, one, 11558, is of inferior quality, having much less protein and fat than should be present and much more fiber. It is made of light and inferior oats or oat hulls or clippings have been mixed with it. Oats contain, on the average, 11.8 per cent. of protein, 5.0 per cent. of fat and 9.5 per cent. of fiber.

Provender.

This is supposed to be a mixture of equal weights of ground corn and oats.

The thirteen analyses show a wide range of composition and two of them at least, 12904 and 11356, have such low percentages of protein together with such large percentages of fiber as to make it probable that oat hulls have been added to them. Provender to be of good quality should certainly contain at least ten per cent. of protein.

Corn and Oat Feeds.

In the table are given analyses of six samples of this class which have about the same composition as provender, most of them containing however a larger percentage of fiber (hulls).

The Victor Corn and Oat Feed, made by the American Cereal Co., is the only brand, in this class, bearing a statement of composition. The guarantee is 9.46 per cent. of protein and 3.92 per cent. of fat. One of the samples, 11365, falls short of the guaranteed protein by nearly one per cent. and of the guaranteed fat by one and three-tenths per cent.

Champion Bell Fodder, 12127, is simply a corn and oat feed of average quality, under another name.

OAT FEEDS.

Analyses of fourteen samples of Oat Feed appear in the table and one of Oat Chaff.

Those made by the American Cereal Co. contain a fair amount of protein and fat.

The same is true of 12903. But all the others contain far less protein than good corn meal even and almost or quite as much woody fiber as good hay.

They are factory wastes of very inferior feeding value, consisting largely of oat chaff, which are sold to dairymen in this State for nearly the same price as good wheat bran.

No feeder can afford to use them, however cheaply he can buy them. They ought not to have a place in the feed market.

Oat chaff, as appears in the table, 12190, can be bought under its true name for $7.00 per ton. It can be bought under the name of "Oat Feed," as also appears in the table, 12197, for $15.00 a ton.

Some of the oat feeds contained some wheat, but no other foreign matter was detected.

The Quaker Oat Feed is the only brand which has the guaranteed statement of composition which the law requires.

This guarantee is, protein 12.03 per cent., fat 3.49 per cent. Only one of the four samples contained the guaranteed amount of protein, and three of them contained much less than this amount.

We are informed by the manufacturers that Quaker Oat Feed is no longer made, being superseded by Quaker Dairy Feed.

Corn, Oats and Barley.

Two samples bearing this brand, made by the American Cereal Co., have about the same composition as their oat feed, though with less fiber.

Other Mixed Feeds.

Feeds made by the H. O. Co., Buffalo, N. Y.

H. O. Dairy Feed. Six samples of this article have been examined. The chemical analyses given in the table show them to have a tolerably uniform composition, differing from bran in having somewhat more protein, considerably more woody fiber and less carbhydrates and fat. Microscopic examination shows them to be mixtures of oats, corn, wheat and cotton seed.

This brand is guaranteed by the manufacturers to contain 18 per cent. of protein and 4.5 per cent. of fat.

Two of the analyses fall slightly below the guaranteed protein and none of the samples contain the guaranteed percentage of fat.

H. O. Horse Feed. Nine samples of this article have been examined. It consist of oats, corn, wheat and linseed. Twelve per cent. of protein are guaranteed in this brand and four and a half per cent. of fat. With one exception the analyses substantially came up to the guaranteed protein, but all show less fat than is guaranteed.

H. O. Poultry Food. Three samples of this material also appear in the table. They contain oats, corn and wheat, and are guaranteed to contain 17 per cent. of protein and 5.50 per cent. of fat.

One of the samples contains two per cent. less of protein and nearly one per cent. less of fat than is guaranteed.

Feeds made by the American Cereal Co., Chicago, Ill.

Quaker Dairy Feed. The analyses of five samples of this feed are given in the table. The feed is composed of oats and wheat and guaranteed to contain 12.09 per cent. of protein and 3.49 per cent. of fat. The percentage of fiber shows the presence of a considerable quantity of oat hulls. In two of the samples the percentage of protein fell below the guaranteed amount. One analysis is also given of the *American Poultry Food,* made by the same company, and one of their *Stock Food.*

Blatchford's Calf Meal.

Called "The Perfect Milk Substitute." The directions for using, however, indicate that for very young calves it is to be used with skim milk and for older calves a double handful is given daily, *in addition to their other feed.* The quality and quantity of the other feed would affect somewhat the profitableness of this feed, which costs $3.50 per 100 pounds.

The sample examined contained linseed meal, a starchy bean meal, wheat middlings, cotton seed meal, carob bean and husk and fenugreek. It contains about the same percentages of protein, fat and nitrogen-free extract as the gluten feeds.

Rye Bran and Rye Feed.

The five samples examined were genuine and of very similar composition. Rye bran sells for the same price as wheat feeds and contains less fat and from one and one-half to two per cent. less of protein. It is of less value in "balancing" a ration than the wheat feeds and therefore cannot be as economical a feed to purchase. All the samples consisted wholly of rye. None of them had any guaranteed statement of composition.

Malt Hulls.

A single analysis, 12261, of this feed shows it to be of inferior value as a feed. It represents a sample sent to T. S. Gold, West Cornwall, by a feed dealer in Chicago.

Starch Feeds.

Schumacher's Starch Feed, **12078**, contains much less protein than wheat bran and is of no value in balancing a ration. It contains oats, corn and wheat. The dry Glen Cove Starch Feed, **12135**, ranks in composition with the gluten feeds, and contains as much protein as the best wheat brans.

Pioneer Clover Meal.

This material, No. 12189, is put up for a poultry food and claims to be, and apparently is, ground clover hay. Its cost is $1.00 for 50 pounds.

Carob Beans.

As this material forms a part of one of the mixed feeds above referred to and as no analyses of beans and pods were at hand, analyses were made both of the beans and pods, from which is calculated the composition of bean and pod together.

In one hundred parts of the unopened pods are 7.5 parts by weight of seed and 92.5 parts of empty "husks" or pods. The analyses were as follows:

	Seeds.	Husks.	Full Pods. (Seed and Husk.)
Water	12.84	14.15	14.05
Ash	3.27	3.25	3.26
Protein	15.00	4.81	5.57
Starch*	....	.85	....
Sugars and dextrines†	5.31	40.63	41.56
Reducing sugar‡	None	3.62	3.25
Other nitrogen-free extract	54.59	27.67	26.99
Fiber	7.16	4.80	4.98
Fat	1.83	.22	.34
	100.00	100.00	100.00

American Cattle Feeding Salts.

No. 12192, made by the American Cattle Feeding Salts Co., 138-140 55th St., New York City. John M. Draper, Agricultural and Research Chemist, Manager.

Said to consist of "various tonic substances and natural salts," which when added to the other feeds is a "means of growing prime beef, brighter in color, wavy or marbled in texture, and with pure white fat, in much less time than is possible under the present system of feeding."

The "Salts" contain about 16 per cent. of common salt, 63½ per cent. of Glaubers salts, 4.8 per cent. of Epsom salts, 9.3 per cent. of carbonate of soda, a per cent. and a half of matter insoluble in water and for the rest contains water and some volatile matter.

The last three analyses of the table are of beef scraps and animal meal used as poultry food.

*By diastase method.

†Carbhydrates soluble in water calculated as dextrose after hydrolizing with acid and deducting "reducing sugars."

‡Reducing power of aqueous extract determined without hydrolysis

TABLE II.—ANALYSES OF COMMERCIAL FEEDS. (☞)

Station No.	Name of Feed.	Manufacturer or Jobber.	Retail Dealer.
12092	Cotton Seed Meal		East Hartford, G. M. White & Son
12125	" Dixie Brand		Hamden, Ira W. Beers
12126	"	Chapin & Co., St. Louis	" "
12103	" American		Hartford, Daniels Mill Co.
12071	"		" C. A. Pease & Co.
12087	"		" Smith, Northam & Co.
11379	"	J. E. Soper & Co., Boston	New Britain, M. D. Stanley
12132	"	" " "	New Haven, R. G. Davis
12149	"		" Abner Hendee
12895	"		" "
			Average of the above 10 analyses of Cotton Seed Meal
			Average of 205 recent analyses
			Highest
			Lowest
12093	Linseed Meal		East Hartford, G. M. White & Son
11395	"		Hartford, Daniels Mill Co.
12074	" "Old Process"		" C. A. Pease & Co.
12088	"		" Smith, Northam & Co.
11392	"	Hunter Bros., St. Louis, Mo.	Middletown, Meech & Stoddard
11385	"	Chapin & Co., Boston	New Britain, Hugh Reynolds
11381	"	J. E. Soper & Co., Boston	" M. D. Stanley
12156	" "Old Process"		New Haven, J. T. Benham
12147	"	Hunter Bros., St. Louis	" Abner Hendee
12894	" "Old Process"		" "
11567	Flax Meal	American Linseed Co.	New London, Beebe & Bragan
11585	Linseed Meal		Willimantic, H. A. Bugbee
			Average of the above 8 analyses of Old Process Linseed Meal
			Average of 25 recent analyses Old Process
			Highest
			Lowest
			Average of the above 4 analyses of New Process Linseed Meal
			Average of 31 recent analyses, New Process
			Highest
			Lowest
12194	Ground Wheat	C. M. Cox & Co., Boston	Torrington, B. C. Patterson
	Bran from Winter Wheat.		
12806	Bran, Winter Wheat		Hartford, Smith, Northam & Co.
12801	" Michigan		" " "
11383	"	City Mills Co., N. Y.	New Britain, Hugh Reynolds
11565	"	Hollister, Crane & Co.	New London, Beebe & Bragan
12131	" Coarse Amber Wheat		New Haven, R. G. Davis

SAMPLED IN 1899.

Station No.	Analyses.						Price per ton.
	Water.	Ash.	Protein.	Fiber.	Nitrogen-Free Extract. (Starch, gum, etc.)	Ether Extract.	
12092	9.10	5.90	48.83	4.24	23.38	8.55	$24.00
12125	8.80	6.72	45.88	4.27	25.30	9.03	23.00
12126	7.72	7.52	44.20	5.70	22.09	12.77	23.00
12103	7.74	7.40	45.76	6.92	21.23	10.95	24.00
12071	8.20	6.48	49.38	4.41	22.54	8.99	25.00
12087	8.85	7.33	46.01	5.33	21.36	11.12	23.00
11379	6.84	7.86	47.00	5.76	21.23	11.31	26.00
12132	9.15	5.88	44.69	5.87	24.83	9.58	25.00
12149	9.09	6.48	48.38	4.87	22.59	8.59	24.00
12895	7.14	7.42	43.94	4.69	23.85	12.96	25.00
	8.26	6.90	46.41	5.53	22.52	10.38	
	----	----	**45.4**	----	----	**11.2**	
	----	----	52.6	----	----	17.0	
	----	----	40.3	----	----	6.5	
12093	10.71	5.56	35.07	7.48	31.59	9.59	28.00
11395	10.71	4.90	36.19	8.56	34.97	4.67	27.00
12074	11.16	5.56	36.07	8.39	36.59	2.23	29.50
12088	9.77	6.24	38.13	8.11	35.04	2.71	26.00
11392	10.28	6.06	34.56	8.00	32.00	9.10	28.00
11385	10.58	5.13	31.81	8.85	36.97	6.66	----
11381	10.20	5.50	32.06	8.79	36.67	6.78	30.00
12156	10.83	5.61	36.26	8.58	36.89	1.83	29.00
12147	9.82	6.62	33.76	7.12	33.54	9.14	28.00
12894	6.94	6.60	34.37	7.08	35.59	9.42	30.00
11567	11.17	5.15	40.44	7.64	32.62	2.98	28.00
11585	9.76	5.64	32.94	8.51	36.89	6.26	30.00
	9.87	5.75	33.84	8.05	34.79	7.70	
	----	----	**35.7**	----	----	**7.2**	
	----	----	38.9	----	----	9.6	
	----	----	31.8	----	----	4.7	
	10.73	5.64	37.72	8.18	35.29	2.44	
	----	----	**38.2**	----	----	**2.4**	
	----	----	42.2	----	----	3.5	
	----	----	34.6	----	---	1.8	
12194	12.02	5.48	18.12	6.34	53.17	4.87	18.00*
12806	12.80	5.00	17.37	6.92	53.99	3.92	----
12801	13.26	6.27	15.69	8.80	51.80	4.18	----
11383	10.84	6.49	15.62	9.01	53.47	4.57	----
11565	11.31	6.16	15.37	9.59	53.18	4.39	21.00
12131	10.17	6.93	16.19	8.18	54.24	4.29	19.00

* Car load lots delivered.

TABLE II.—*Continued.* ANALYSES OF COMMERCIAL FEEDS. (☞)

Station No.	Name of Feed.	Manufacturer or Jobber.	Retail Dealer.
12151	Bran, White Mich.	----------	New Haven, J. T. Benham
12900	" White Wheat	----------	" Abner Hendee
11576	" ----------	Valley City Milling Co., Grand Rapids	Norwich, Joseph Connor & Son
			Average of the above 8 analyses of Winter Wheat Bran
			Average of 45 recent analyses
			Highest
			Lowest
	Bran from Spring Wheat.		
11372	Bran, Spring Wheat	Pillsbury	Berlin, T. B. Wickwire
12096	" ----------	----------	East Hartford, G. M. White & Co.
11398	" ----------	Freeman Milling Co.	Hartford, Daniels Mill Co.
12805	" ----------	Pillsbury	" Smith, Northam & Co.
12081	" ----------	" ----------	" E. P. Yates & Co.
11384	" ----------	Washburn, Crosby Co.	New Britain, Hugh Reynolds
12152	" Coarse	----------	New Haven, J. T. Benham
12906	" Red Wheat	----------	" Abner Hendee
11569	" ----------	Washburn, Crosby Co.	New London, Arnold Rudd
			Average of the above 9 analyses of Spring Wheat Bran
			Average of 53 recent analyses
			Highest
			Lowest
	Bran Unclassified.		
12115	Bran	T. B. Chase & Son, N. Y.	Bridgeport, Taylor & Clark
12077	" ----------	----------	Hartford, Cummings & Garvin
12065	" ----------	----------	" C. A. Pease & Co.
11389	" ----------	Ferguson & Lewis, Rochester	Middletown, Meech & Stoddard
	Middlings, Spring Wheat		
12800	A	Pillsbury	Hartford, Smith, Northam & Co.
12804	B	" ----------	" " "
11396	B	" ----------	" Daniels Mill Co.
12160	----------	----------	New Haven, J. T. Benham
12137	Coarse	Northwestern Consolidated Milling Co., Minneapolis	" R. G. Davis
12901	No. 2	----------	" Abner Hendee
			Average of the above 6 analyses of Spring Wheat Middlings
			Average of 60 recent analyses
			Highest
			Lowest
	Middlings, Winter Wheat.		
11575	----------	Valley City Milling Co., Grand Rapids	Norwich, Joseph Connor & Sons
			Average of 20 recent analyses
			Highest
			Lowest

SAMPLED IN 1899.

Station No.	Analyses.						Price per ton.
	Water.	Ash.	Protein.	Fiber.	Nitrogen-Free Extract. (Starch, gum, etc.)	Ether Extract.	
12151	9.98	5.98	16.13	8.20	55.20	4.51	$19.00
12900	8.06	6.53	15.94	8.74	56.61	4.12	20.00
11576	11.40	5.33	15.25	8.32	55.37	4.33	----
	10.98	6.08	15.94	8.46	54.25	4.29	
	----	----	**15.5**	----	----	**4.4**	
	----	----	17.8	----	----	5.6	
	----	----	13.6	----	----	3.5	
11372	10.53	6.98	15.56	12.12	49.87	4.94	19.00
12096	9.74	6.51	16.37	8.87	53.37	5.14	20.00
11398	11.88	5.80	15.81	7.83	54.26	4.42	20.00
12805	12.99	6.72	15.06	10.96	49.84	4.43	---
12081	11.31	6.54	15.75	10.42	50.92	5.06	20.00
11384	11.45	6.40	15.12	10.37	52.03	4.63	----
12152	10.25	6.54	15.31	11.56	51.28	5.06	18.00
12906	8.20	5.86	16.37	9.11	55.95	4.51	18.00
11569	11.44	6.01	15.44	10.59	52.15	4.37	19.00
	10.86	6.37	15.64	10.20	52.20	4.73	
	----	----	**16.1**	----	----	**4.9**	
	----	----	17.5	----	----	5.6	
	----	----	15.1	----	----	4.4	
12115	9.86	6.27	15.75	9.68	53.76	4.68	18.00
12077	10.39	5.79	16.94	8.04	53.78	5.06	20.00
12065	10.75	6.35	15.75	9.46	52.86	4.83	20.50
11389	11.65	5.50	15.31	8.50	54.91	4.13	21.50
12800	12.18	3.33	18.06	5.36	56.26	4.81	----
12804	12.28	5.30	16.50	9.53	51.04	5.35	----
11396	11.48	5.52	17.19	10.26	50.06	5.49	21.00
12160	11.06	4.71	17.32	9.48	51.67	5.76	19.00
12137	11.63	5.45	16.00	10.31	51.57	5.04	17.00
12901	8.43	5.18	16.69	10.07	54.38	5.25	20.00
	11.17	4.91	16.96	9.17	52.51	5.28	
	----	----	**18.8**	----	----	**5.2**	
	----	----	22.2	----	----	7.1	
	----	----	16.0	----	----	3.3	
11575	11.76	4.37	15.87	6.87	56.71	4.42	19.00
			16.0			**4.8**	
			17.9			5.1	
			12.4			4.4	

TABLE II.—*Continued.* ANALYSES OF COMMERCIAL FEEDS. (☞)

Station No.	Name of Feed.	Manufacturer or Jobber.	Retail Dealer.
	Middlings, unclassified.		
12113	----------	T. B. Chase & Son, New York----------	Bridgeport, Taylor & Clark------
12111	----------	----------	Bristol, W. O. Goodsell----------
11557	Puritan ----------	J. T. Benham, New Haven	Guilford, G. F. Walter----------
12067	N. Y. Brand No. 2 ----	----------	Hartford, C. A. Pease & Co. -----
12066	No. 1 N. Y. Brand ----	----------	" " " -----
12084	----------	----------	" E. P. Yates & Co.------
12159	White ----------	----------	New Haven, J. T. Benham------
12142	Fine ----------	----------	" R. G. Davis---------
12144	Fine ----------	----------	" Abner Hendee -----
12143	Coarse ----------	----------	" " -----
11566	----------	New York City Mills----	New London, Beebe & Bragan ---
11571	----------	Whitney & Wilson, Rochester----------	" Arnold Rudd------
11578	----------	F. W. Stock, Millsdale, Mich. ----------	Norwich, A. A. Beckwith--------
12195	----------	C. M. Cox & Co., Boston	Torrington, B. C. Patterson------
12193	----------	" "	" " ------
11584	----------	Bay State Co., Winona, Minn.----------	Willimantic, H. A. Bugbee ------
14012	Middlings, Colonial---	Miner, Hillard MillingCo.	New Haven, Abner Hendee -----
	Mixed Feed from Winter Wheat.		
11367	Anchor----------	C. M. Cox & Co., Boston	Berlin, J. C. Lincoln----------
11368	Buckeye----------	American Cereal Co., Chicago ----------	" " ----------
11559	" ----------	American Cereal Co., Chicago ----------	Guilford, F. H. Rolf----------
11560	I. Harter Co.'s --------	Isaac Harter Co., Toledo	" " ----------
12122	Coarse ----------	----------	Hamden, Ira W. Beers ----------
12121	Medium Snow Flake Brand ----------	----------	" " ----------
11397	Anchor----------	Anchor Mill Co., Superior	Hartford, Daniels Mill Co.-------
12069	Acme ----------	----------	" C. A. Pease & Co.-----
12802	----------	----------	" Smith, Northam & Co..
11359	Snow Flake Brand ----	Lawrenceberg Mills Co., Ind.----------	Meriden,Meriden Grain & Feed Co.
11364	Buckeye----------	American Cereal Co., Chicago ----------	" A. H. Cashen----------
11378	Snow Flake----------	Lawrenceberg Mills Co., Ind.----------	New Britain, M. D. Stanley------
11387	Hannibal Mixed Feed-	Hannibal Milling Co., Hannibal, Mo.--------	" Hugh Reynolds----
12153	----------	----------	New Haven, J. T. Benham-------
12128	----------	----------	" R. G. Davis --------
14017	Snow Flake Brand ----	C. M. Cox & Co., Boston	North Haven, The Co-Op. Feed Co.
11594	Acme Feed----------	Acme Co., Indianapolis--	Rockville, Edward White--------
14016	Mixed Feed----------	Miles & Son, Frankfort, Ky. ----------	North Haven,Cooperative Feed Co.

Sampled in 1899.

Station No.	Analyses.						Price per ton.
	Water.	Ash.	Protein.	Fiber.	Nitrogen-Free Extract. (Starch, gum, etc.)	Ether Extract.	
12113	11.58	4.18	18.63	5.00	54.35	6.26	$19.00
12111	11.07	4.29	14.38	5.57	60.34	4.35	----
11557	11.86	4.24	17.56	7.11	54.40	4.83	21.00
12067	10.44	4.30	18.44	6.59	55.18	5.05	20.00
12066	10.50	4.32	20.13	4.68	54.60	5.77	21.50
12084	13.92	5.27	19.19	6.98	52.92	1.72	21.00
12159	12.23	2.86	13.69	3.03	65.31	2.88	20.00
12142	12.08	4.44	17.25	4.94	55.88	5.41	18.00
12144	12.61	3.68	12.85	1.05	67.15	2.70	20.00
12143	11.32	4.69	17.88	8.11	52.09	5.91	18.00
11566	10.92	4.91	17.75	4.48	54.24	7.70	21.00
11571	12.74	3.58	17.31	6.31	54.56	5.50	20.00
11578	11.75	4.34	16.19	6.16	59.72	1.84	21.00
12195	12.50	4.88	19.44	6.78	50.76	5.64	16.00*
12193	12.74	2.86	14.87	4.05	61.68	3.80	17.25*
11584	11.62	4.38	18.62	8.13	51.69	5.56	19.00
14012	7.85	3.75	13.75	5.48	62.37	6.80	20.00
11367	10.93	5.34	16.56	8.28	53.79	5.10	20.00
11368	11.27	5.48	17.12	7.21	54.55	4.37	20.00
11559	12.11	4.97	17.75	6.82	53.98	4.37	20.00
11560	11.69	5.04	15.75	6.76	56.49	4.27	20.00
12122	9.73	6.57	17.13	7.90	54.08	4.59	18.00
12121	9.97	6.06	16.75	7.41	55.28	4.53	18.00
11397	11.58	5.06	16.12	8.94	53.10	5.20	21.00
12069	10.18	6.33	17.00	6.97	54.92	4.60	20.00
12802	13.28	5.11	18.12	6.48	53.41	3.60	----
11359	11.02	4.86	17.31	7.57	54.96	4.28	20.00
11364	11.30	5.39	16.37	6.55	55.98	4.41	20.00
11378	10.76	5.45	17.56	7.26	54.67	4.30	21.00
11387	11.75	4.37	15.56	6.95	57.32	4.05	20.00
12153	10.68	5.94	16.63	7.22	54.74	4.79	18.50
12128	10.88	5.96	16.32	7.04	55.22	4.58	18.00
14017	8.94	5.42	17.62	8.95	54.20	4.87	18.00
11594	11.24	5.48	17.50	7.15	54.63	4.00	20.00
14016	8.16	6.75	16.37	9.22	54.33	5.17	18.00

* Car load lots delivered.

TABLE II.—*Continued.* ANALYSES OF COMMERCIAL FEEDS. (☞).

Station No.	Name of Feed.	Manufacturer or Jobber.	Retail Dealer.
11355	Sunshine Mixed Feed	Hunter Bros., St. Louis	Wallingford, E. E. Hall
			Average of the above 19 analyses of feed from Winter Wheat
			Average of 88 recent analyses
			Highest
	Mixed Feed from Spring Wheat.		Lowest
12120	Best Fine		Hamden, Ira W. Beers
12106	Anchor		Hartford, E. H. Arnold & Son
12105	Minkota		" " " "
12803	No. 2	Pillsbury	" Smith, Northam & Co.
12086		"	" " " "
12082		"	" E. P. Yates & Co.
11375	Superior Mixed Feed	Lake Superior Mills, Wis.	New Britain, C. W. Lines
11376	Golden Bull Mixed Feed	Bay State Milling Co., Winona, Minn.	" " "
14018	Boston	Imperial Mill Co., Duluth	North Haven, The Co-Op. Feed Co.
			Average of the above 9 analyses of feed from Spring Wheat
			Average of 60 recent analyses
			Highest
			Lowest
	Mixed Feed, unclassified.		
11370		Hollister, Crane & Co., N. Y.	Berlin, J. C. Lincoln
11373			" T. B. Wickwire
12116	Boston Feed	T. B. Chase & Son, N. Y.	Bridgeport, Taylor & Clark
12090	No. 1		East Hartford, G. M. White & Co.
12091	No. 2		" "
12099	Michigan Stock Food		Hartford, Daniels Mill Co.
12101	St. Louis Mixed Feed		" "
12102	Boston "		" "
11393	St. Louis "		" "
12070	Boston "		" C. A. Pease & Co.
11555	Mixed Feed	N. Y. City Mills	" E. P. Yates & Co.
11357	Stirling Mixed Feed	Chapin & Co., Boston	Meriden, S. A. Billings
11360	Mixed Feed	" "	" Meriden Grain and Feed Co.
12109			New Canaan, Grange
12902			New Haven, Abner Hendee
12158			" "
12196	New York Mixed Feed		" R. G. Davis
11591		Hecker Jones Milling Co.	Willimantic, E. A. Buck & Co.
11590	Sterling Mixed Feed	Chapin & Co.	" "
11586	" "	"	" H. A. Bugbee
	Corn Meal.		
12112		W. M. Terry, Bridgeport	Bridgeport, Taylor & Clark
12089		Smith, Northam & Co., Hartford	East Hartford, G. M. White & Co.

Sampled in 1899.

Station No.	Analyses.						Price per ton.
	Water.	Ash.	Protein.	Fiber.	Nitrogen-Free Extract. (Starch, gum, etc.)	Ether Extract.	
11355	10.92	4.65	17.00	6.66	56.72	4.05	$20.00
	10.86	5.48	16.87	7.44	54.87	4.48	
	----	----	**16.2**	----	----	**4.5**	
	----	----	18.5	----	----	5.4	
	----	----	13.8	----	----	3.6	
12120	10.42	5.26	16.25	8.27	54.30	5.50	18.00
12106	10.29	5.26	16.75	7.83	54.97	4.90	20.00
12105	11.20	3.75	16.00	5.20	59.63	4.22	20.00
12803	12.05	3.51	15.56	9.36	54.66	4.86	----
12086	10.19	7.11	18.75	9.41	49 45	5.09	18.00
12082	11.16	6.27	17.38	8.57	51.51	5.11	20.00
11375	11.12	5.00	16.69	8.80	53.33	5.06	20.00
11376	11.12	5.75	16.75	9.18	51.56	5.64	20.00
14018	10.08	4.80	16.81	8.05	55.00	5.26	18 00
	10.85	5.18	16.77	8.29	53.84	5.07	
	----	----	**17.3**	----	----	**4.9**	
	----	----	19.8	----	----	5.5	
	----	----	15.6	----	----	3.8	
11370	11.01	5.87	17.50	6.52	54.98	4.12	20.00
11373	11.02	5.27	16.50	8.67	54.16	4.38	20.00
12116	11.00	4.56	16.13	5.57	58.20	4.54	----
12090	10.46	6.05	15.82	6.33	56.77	4.57	20.00
12091	10.79	5.64	16.00	7.04	56.07	4.46	20.00
12099	10.14	5.60	15.00	6.97	57.92	4.37	19.00
12101	10.43	5.37	16.31	7.50	54.99	5.40	19.00
12102	10.17	4.98	16.88	6.75	56.68	4.54	19.00
11393	12.00	5.06	17.62	7.24	54.17	3.91	21.00
12070	10.72	5.04	16.88	6.53	55.37	5.46	20.00
11555	12.00	5.32	16.19	8.65	53.22	4.62	21.00
11357	10.85	5.90	17.81	7.54	53.49	4.41	20.00
11360	10.66	5.85	17.50	7.43	53.56	5.00	20.00
12109	8.06	4.99	19.13	7.43	54.57	5.82	14.00*
12902	8.03	5.98	16.19	9.11	55.96	4.73	20.00
12158	10.87	5.47	18.00	7.66	53.98	4.02	18.00
12196	11.22	5.99	16.00	8.58	53.23	4.98	19.00
11591	12.10	5.78	15.50	9.03	53.46	4.13	20.00
11590	10.61	5.60	19.00	7.94	52.85	4.00	20.00
11586	11.02	5.72	17.19	8.73	53.04	4.30	20.00
12112	14.30	1.31	10.25	2.45	67.98	3.71	17.00
12089	13.91	1.45	9.88	1.50	68.90	4.36	19.00

* Car load lots.

TABLE II.—*Continued.* ANALYSES OF COMMERCIAL FEEDS. (☞)

Station No.	Name of Feed.	Manufacturer or Jobber.	Retail Dealer.
12104			Hartford, E. H. Arnold & Son
12076			" Cummings & Garvin
12097			" Daniels Mill Co.
12064			" C. A. Pease & Son
12079			" E. P. Yates & Co.
11604			Middlefield, S. E. Miller
12138			New Haven, R. G. Davis
			Average of the above 9 analyses of Corn Meal
			Average of 17 recent analyses
			Highest
			Lowest
11388	Atlantic Gluten Meal*	Atlantic Starch Works,	Middletown, Meech & Stoddard
12136	" "	Westport, Conn.	New Haven, R. G. Davis
12095	Chicago Gluten Meal	Glucose Sugar Refin'g Co.	East Hartford, G. M. White & Co.
12068	" "	" "	Hartford, C. A. Pease & Co.
12080	" "	" "	" E. P. Yates & Co.
11386	" "	" "	New Britain, Hugh Reynolds
11380	" "	" "	" M. D. Stanley
			Average of the above 5 analyses of Chicago Gluten Meal
			Average of 76 recent analyses
			Highest
			Lowest
11394	Cream Gluten		Hartford, Daniels Mill Co.
12085	"		" Smith, Northam & Co.
11361	"		Meriden, Meriden Grain and Feed Co.
11577	"		Norwich, A. A. Beckwith
			Average of the above 4 analyses of Cream Gluten
			Average of 40 recent analyses
			Highest
			Lowest
11600	King Gluten Meal	Natl. Starch Mfg. Co. (Indianapolis Mill).	Sent by A. Cullen & Co., N. Y. City
			Average of 10 recent analyses
			Highest
			Lowest
12108	King Gluten Meal	Natl. Starch Mfg. Co. (Des Moines Mill).	West Hartford, C. M. Beach
			Average of 39 analyses
			Highest
			Lowest
11599	Gluten Feed, Buffalo	Glucose Sugar Refining Co., Chicago	Bridgeport, Berkshire Mills
11574	" "	Glucose Sugar Refining Co., Chicago	Groton, Groton Grain Co.

*Made from wheat.

SAMPLED IN 1899.

Station No.	Analyses.						Price per ton.
	Water.	Ash.	Protein.	Fiber.	Nitrogen-Free Extract. (Starch, gum, etc.)	Ether Extract.	
12104	13.39	1.22	9.75	1.96	69.74	3.94	$19.00
12076	14.25	1.65	9.45	1.71	68.24	4.70	19.00
12097	14.65	1.56	9.44	1.71	68.20	4.44	18.00
12064	17.38	1.40	9.56	1.65	66.82	3.19	19.00
12079	13.61	1.91	9.56	1.66	69.05	4.21	19.00
11604	12.35	1.26	10.00	1.75	70.96	3.68	----
12138	16.54	1.39	9.51	1.63	67.14	3.79	19.00
	14.49	1.46	9.71	1.78	68.56	4.00	
	----	----	**9.5**	----	----	**4.0**	
	----	----	10.8	----	----	4.7	
	----	----	8.6	----	----	2.7	
11388	8.66	1.12	48.75	0.85	38.92	1.70	25.00
12136	7.26	1.07	49.06	0.88	39.69	2.04	21.00
12095	10.26	1.05	41.29	1.10	44.43	1.87	23.00
12068	11.86	1.83	35.94	1.50	46.85	2.02	23.50
12080	17.16	1.22	36.25	1.41	42.34	1.62	24.00
11386	11.56	1.85	37.75	1.52	44.69	2.63	30.00
11380	10.79	0.60	34.62	1.56	48.24	4.19	25.00
	12.32	1.31	37.17	1.42	45.32	2.46	
	----	----	**36.7**	----	----	**2.7**	
	----	----	41.3	----	----	7.6	
	----	----	31.7	----	----	1.4	
11394	10.00	0.99	32.12	2.36	52.24	2.29	25.00
12085	11.25	0.95	34.94	1.35	47.73	3.78	20.00
11161	9.90	0.54	35.37	1.43	51.06	1.70	24.00
11577	9.27	0.84	34.12	1.49	52.30	1.98	25.00
	10.10	0.83	34.14	1.65	50.84	2.44	
	----	----	**34.1**	----	----	**3.2**	
	----	----	41.3	----	----	6.1	
	----	----	30.1	----	----	1.6	
11600	7.40	0.45	33.12	1.21	55.03	2.79	----
	---	----	**34.62**	----	----	**4.80**	
	----	----	37.32	----	----	6.87	
	----	----	32.11	----	----	2.65	
12108	8.15	0.89	32.07	1.93	41.69	15.27	----
	----	----	**32.89**	----	----	**15.35**	
	----	----	37.06	----	----	19.77	
	----	----	26.38	----	----	11.71	
11599	10.10	2.60	27.00	7.10	50.03	3.17	20.00
11574	10.12	1.67	27.12	7.27	51.48	2.34	25.00

TABLE II.—*Continued.* ANALYSES OF COMMERCIAL FEEDS. (☞)

Station No.	Name of Feed.	Manufacturer or Jobber.	Retail Dealer.
12123	Gluten Feed, Buffalo	Glucose Sugar Refining Co., Chicago	Hamden, Ira W. Beers
11377	" "	Glucose Sugar Refining Co., Chicago	New Britain, C. W. Lines
12155	" "	Glucose Sugar Refining Co., Chicago	New Haven, J. T. Benham
14015	" "	Glucose Sugar Refining Co., Chicago	North Haven, Cooperative Feed Co.
12150	" Rockford	Glucose Sugar Refining Co., Chicago	New Haven, Abner Hendee
12899	" "	Glucose Sugar Refining Co., Chicago	" " "
11570	" "	Glucose Sugar Refining Co., Chicago	New London, Arnold Rudd
			Average of the above 6 analyses of Buffalo Gluten Feed
			Average of 34 recent analyses
			Highest
			Lowest
11568	Golden Gluten Feed	Glucose Sugar Refining Co.	New London, Beebe & Brogan
			Average of 15 recent analyses
			Highest
			Lowest
12133	Diamond Gluten Feed	Glucose Sugar Refining Co.	New Haven, R. G. Davis
11597	" " "	Glucose Sugar Refining Co.	Rockville, Edward White
			Average of 30 recent analyses
			Highest
			Lowest
12821	Gluten Feed	National Starch Mfg. Co.	
11598	"	" "	Bridgeport, Berkshire Mills Co.
11374	Gluten		Berlin, T. B. Wickwire
12124	Gluten Meal		Hamden, Ira W. Beers
	Hominy Chop.		
11562		American Cereal Co.	Guilford, F. H. Rolf
12129			New Haven, R. G. Davis
12908	" White Meal "		" Abner Hendee
14019	"	C. M. Cox & Co., Boston	North Haven, Co-öp. Feed Co.
14011	" Hominy Meal "	Miner, Hillard Co., Wilkesbarre	Meriden, A. H. Cashen
11603	"	Indianapolis H. Co.	Middlefield, S. E. Miller
11391	"	C. M. Cox & Co., Boston	Middletown, Meech & Stoddard
11354	"	Chapin & Co., Boston	Wallingford, E. E. Hall
			Average of the above 8 analyses of Hominy Chop
			Average of 20 recent analyses
			Highest
			Lowest

SAMPLED IN 1899.

Station No.	Analyses.						Price per ton.
	Water.	Ash.	Protein.	Fiber.	Nitrogen-Free Extract. (Starch, gum, etc.)	Ether Extract.	
12123	9.85	2.60	28.57	6.08	49.73	3.17	$18.50
11377	9.20	1.55	27.75	6.60	50.81	4.09	23.00
12155	10.04	2.83	26.32	6.58	51.24	2.99	19.00
14015	8.46	2.39	27.12	6.85	51.48	3 70	18.00
12150	8.77	0.90	25.19	7.07	54.30	3.77	19.00
12899	7.21	0.64	22.81	6.34	59.79	3.21	20.00
11570	9.55	0.88	30.12	6.85	49.26	3.34	19.00
	9.63	2.27	27.31	6.74	50.80	3.25	
	----	----	**27.5**	----	----	**3.1**	
	----	----	29.6	----	----	4.7	
	----	----	25.3	----	----	2.3	
11568	8.48	0.82	27.25	6.58	53.12	3.75	22.00
	----	----	**27.00**	----	----	**3.00**	
	----	----	29.6	----	----	4.0	
	----	----	23.6	----	----	2.0	
12133	9.87	0.88	23.69	5.85	56.14	3.57	19.00
11597	8.99	0.72	24.37	6.65	55.75	3.52	22.00
	----	----	**23.6**	----	----	**3.6**	
	----	----	30.1	----	----	5.0	
	----	----	20.3	----	----	2.3	
12821	7.35	0.60	21.37	7.43	57.07	6.18	----
11598	6.77	0.88	19.87	7.63	53.33	11.52	20.00
11374	9.75	0.40	26.19	3.58	56.37	3.71	20.00
12124	8.17	0.98	18.94	7.94	53.25	10.72	18.00
11562	10.65	2.46	11.25	7.61	62.92	5.11	19.00
12129	7.14	3.00	12.00	4.01	64.36	9.49	18.00
12908	6.85	1.93	11.37	3.22	69.07	7.56	18.00
14019	7.85	2.45	11.25	5.96	63.23	9.26	17.00
14011	6.36	2.81	10.87	4.18	67.32	8.46	16.50
11603	9.66	3.32	11.06	5.10	61.86	9.00	----
11391	10.20	2.80	11.75	5.43	61.15	8.67	18.00
11354	8.71	1.95	11.25	3.85	67.31	6.93	18.00
	8.43	2.60	11.35	4.92	64.64	8.06	
	----	----	**11.2**	----	----	**7.8**	
	----	----	12.0	----	----	9.7	
	----	----	10.3	----	----	4.0	

TABLE II.—*Continued.* ANALYSES OF COMMERCIAL FEEDS. (☞)

Station No.	Name of Feed.	Manufacturer or Jobber.	Retail Dealer.
11371	Ground Oats	Miner & Hillard Co., Wilkesbarre	Berlin, J. C. Lincoln
11558	"	R. J. Hardy, Boston	Guilford, G. F. Walters
	Provender.		
11573		Valley Grain Co., Brattleboro, Vt.	Groton, Groton Grain Co.
11556		Guilford Town Mill	Guilford, G. F. Walters
12075			Hartford, C. A. Pease & Co.
11554		M. L. Crittenden, Buffalo	" E. P. Yates & Co.
11605		S. E. Miller	Middlefield, S. E. Miller
12140		American Cereal Co.	New Haven, R. G. Davis
12154	Benham's	J. T. Benham	" J. T. Benham
12904			" Abner Hendee
11572		E. W. Bailey & Co., Montpelier, Vt.	New London, Arnold Rudd
11581		Cutler Co., N. Wilbraham, Mass.	Norwich, Norwich Grain Co.
11356		American Cereal Co., Chicago	Wallingford, E. E. Hall
11589		E. A. Buck & Co.	Willimantic, E. A. Buck & Co.
11592		M. L. Crittenden, Buffalo	" W. D. Grant
			Average of the above 13 analyses of Hominy Chop
			Average of 22 recent analyses
			Highest
			Lowest
12819	Corn and Oat Feed	Miner, Hillard Co., Wilkesbarre, Pa.	Torrington, Geo. W. Greene
11382	Defiance Corn and Oat Feed	H-O. Co., Buffalo	New Britain, Hugh Reynolds
11369	Victor Corn and Oat Feed	American Cereal Co.	Berlin, J. C. Lincoln
11564	Victor Corn and Oat Feed	" "	Guilford, F. H. Rolf
11365	Victor Corn and Oat Feed	" "	Meriden, A. H. Cashen
11593	Victor Corn and Oat Feed	" "	Rockville, Edw. White
12127	Champion Bell Fodder	Hollister, Crane & Co., N. Y.	New Haven, R. G. Davis
12098	Quaker Oat Feed	Amer'n Cereal Co., Chi'go	Hartford, Daniels Mill Co.
12073	" "	" " "	" C. A. Pease & Co.
12148	" "	" " "	New Haven, Abner Hendee
11596	" "	" " "	Rockville, Edward White
11583	" "	" " "	Willimantic, H. A. Bugbee
			Average of the above 5 analyses of Quaker Oat Feed
			Average of 36 recent analyses
			Highest
			Lowest

SAMPLED IN 1899.

Station No.	Analyses.						Price per ton.
	Water.	Ash.	Protein.	Fiber.	Nitrogen-Free Extract. (Starch, gum, etc.)	Ether Extract.	
11371	10.10	3.69	10.94	10.35	59.94	4.98	----
11558	9.69	4.78	8.25	19.67	54.46	3.15	$16.00
11573	12.72	1.87	8.94	4.51	67.59	4.37	20.00
11556	12.36	1.94	10.50	4.53	66.30	4.37	21.00
12075	11.59	2.53	10.44	5.10	65.81	4.53	21.50
11554	10.96	3.03	9.50	13.85	59.33	3.33	20.00
11605	12.00	1.80	10.56	4.52	66.79	4.33	----
12140	11.28	4.36	9.25	9.52	61.44	4.15	19.00
12154	11.99	1.81	10.13	4.18	67.48	4.41	20.00
12904	8.35	3.61	7.94	13.75	63.21	3.14	18.00
11572	12.08	1.82	8.87	6.14	67.46	3.63	20.00
11581	12.55	1.81	10.00	3.85	66.97	4.82	20.00
11356	9.11	3.83	7.94	15.28	60.89	2.95	19.00
11589	12.65	1.88	10.81	5.27	65.18	4.21	21.00
11592	10.24	4.02	9.25	13.40	59.82	3.27	20.00
	11.57	2.64	9.55	7.99	64.49	3.96	
	----	----	9.4	----	----	3.8	
	----	----	11.4	----	----	5.4	
	----	----	7.4	----	----	2.4	
12819	7.13	3.98	10.56	3.06	70.92	4.35	20.00
11382	9.86	4.44	9.37	13.54	59.64	3.15	----
11369	8.77	4.12	9.87	12.85	59.78	4.61	18.00
11564	11.08	3.58	9.37	11.83	60.16	3.98	20.00
11365	10.66	3.77	8.50	12.85	61.53	2.69	19.00
11593	9.03	4.72	10.62	13 60	57.80	4.23	19.00
12127	9.14	3.31	9.88	12.88	59.75	5.04	18.00
12098	7.44	5.25	11.44	17.16	54.71	4.00	18.00
12073	7.95	5.39	11.56	15.83	55.30	3.97	19.50
12148	8.37	5.30	10.25	19.58	53.80	2.70	17.00
11596	8.42	5.05	13.12	17.73	51.83	3.85	18.00
11583	7.90	4.77	11.94	18.95	53.01	3.43	18.00
	8.01	5.15	11.66	17.85	53.74	3.59	
	----	----	10.26	----	----	3.4	
	----	----	12.8	----	----	4.3	
	----	----	7.4	---	----	2.7	

TABLE II.—*Continued.* ANALYSES OF COMMERCIAL FEEDS. (☞)

Station No.	Name of Feed.	Manufacturer or Jobber.	Retail Dealer.
12820	Crescent Oat Feed	A. Cullen & Co., N. York	
11400	Joliet Oat Feed		Hartford, E. P. Yates & Co.
12083	" "		" " " "
12114	Oat Feed	T. B. Chase & Son, N. Y.	Bridgeport, Taylor & Clarke
12107	" No. 2		Hartford, E. H. Arnold & Son
12100	" No. 2		" Daniels Mill Co.
11606	"	Illinois Cereal Co.	Middlefield, S. E. Miller
12903	"		New Haven, Abner Hendee
12197	"		Putnam, J. W. Andrews
12190	Oat Chaff		New Haven, R. G. Davis
12091	Corn, Oats and Barley	American Cereal Co.	East Hartford, G. M. White & Co.
11561	" " "	" "	Guilford, F. H. Rolf
11366	Quaker Dairy Feed	American Cereal Co., Chicago	Berlin, J. C. Lincoln
11563	" "	American Cereal Co., Chicago	Guilford, F. H. Rolf
11390	" "	American Cereal Co., Chicago	Middletown, Meech & Stoddard
12134	" "	American Cereal Co., Chicago	New Haven, R. G. Davis
11579	" "	American Cereal Co., Chicago	Norwich, A. A. Beckwith
			Average of the above 5 analyses of Quaker Dairy Feed
12094	Stock Food, Corn, Oats and Barley	American Cereal Co.	East Hartford, G. M. White & Co.
11595	American Poultry Food	American Cereal Co.	Rockville, Edward White
			Average of 14 recent analyses
			Highest
			Lowest
11363	H-O Dairy Feed	H-O Co., Buffalo, N. Y.	Meriden, Meriden Grain and Feed Co.
12141	" "	" " "	New Haven, R. G. Davis
12907	" "	" " "	" Abner Hendee
11582	" "	" " "	Norwich, Norwich Grain and Feed Co.
11352	" "	" " "	Wallingford, E. E. Hall
11587	" "	" " "	Willimantic, H. A. Bugbee
			Average of the above 6 analyses of H-O Dairy Feed
			Average of 20 recent analyses
			Highest
			Lowest

Sampled in 1899.

Station No.	Analyses.						Price per ton.
	Water.	Ash.	Protein.	Fiber.	Nitrogen-Free Extract. (Starch, gum, etc.)	Ether Extract.	
12820	6.36	5.60	7.25	23.28	54.34	3.17	----
11400	9.35	5.23	8.94	21.80	52.03	2.65	$19.00
12083	8.26	5.12	7.88	20.55	55.14	3.05	19.00
12114	7.24	5.77	8.75	21.88	53.50	2.86	16.00
12107	6.74	5.93	6.44	26.64	51.59	2.66	19.00
12100	6.20	5.77	7.06	24.88	53.30	2.79	16.00
11606	8.51	5.78	6.87	27.19	49.18	2.47	----
12903	6.67	4.71	11.25	20.22	54.38	2.77	15.00
12197	9.03	4.19	4.37	28.11	52.81	1.49	15.00
12190	7.80	7.48	5.12	28.53	49.17	1.60	7.00
12091	9.33	4.46	12.50	11.33	57.71	4.67	20.00
11561	9.60	4.48	11.31	13.15	56.85	4.61	21.00
11366	8.26	4.89	13.19	16.12	53.74	3.80	18.00
11563	9.50	5.27	11.31	18.47	51.94	3.51	19.00
11390	7.86	4.92	13.75	17.39	52.34	3.74	19.00
12134	8.02	5.30	11.69	15.66	54.98	4.35	17.00
11579	7.94	4.63	14.12	16.62	52.73	3.96	18.00
	8.31	5.00	12.81	16.85	53.16	3.87	
12094	9.33	4.46	12.50	11.33	57.71	4.67	20.00
11595	9.56	2.95	13.62	7.20	60.49	6.18	24.00
	----	----	17.5	----	----	5.5	
	----	----	19.5	----	----	6.0	
	----	----	15.0	----	----	4.7	
11363	9.00	2.82	17.31	13.15	53.72	4.00	22.00
12141	9.67	4.50	20.32	12.46	48.88	4.17	19.00
12907	7.57	3.47	18.75	13.10	53.42	3.69	21.00
11582	8.59	3.51	18.69	13.40	51.94	3.87	21.00
11352	8.80	4.45	18.87	12.18	51.47	4.23	22.00
11587	9.31	4.21	17.62	15.27	49.79	3.80	21.00
	8.82	3.83	18.59	13.26	51.54	3.96	
	----	----	19.0	----	----	4.4	
	----	----	21.2	----	----	5.4	
	----	----	15.5	----	----	3.7	

TABLE II.—*Continued.* ANALYSES OF COMMERCIAL FEEDS. (☞)

Station No.	Name of Feed.	Manufacturer or Jobber.	Retail Dealer.
12110	H-O Horse Feed	H-O Co., Buffalo, N. Y.	Bristol, Geo. Eaton
11399	" "	" " "	Hartford, Daniels Mill Co.
11362	" "	" " "	Meriden, Meriden Grain and Feed Co.
12139	" "	" " "	New Haven, R. G. Davis
12145	" "	" " "	" Abner Hendee
12897	" "	" " "	" " "
11580	" "	" " "	Norwich, Norwich Grain Co.
11351	" "	" " "	Wallingford, E. E. Hall
11588	" "	" " "	Willimantic, H. A. Bugbee
			Average of the above 9 analyses of H-O Horse Feed
			Average 18 recent analyses
			Highest
			Lowest
12191	H-O Poultry Food	H-O Co., Buffalo	New Haven, R. G. Davis
12898	" "	" "	" Abner Hendee
11353	" "	" "	Wallingford, E. E. Hall
			Average of the above 3 analyses of H-O Poultry Feed
			Average of 14 recent analyses
			Highest
			Lowest
12072	Rye Bran		Hartford, C. A. Pease & Co.
12157	"		New Haven, J. T. Benham
12130	"		" R. G. Davis
12146	"		" Abner Hendee
12905	Rye Feed		" "
12261	Malt Hulls	H. C. Edwards, Chicago	West Cornwall, T. S. Gold*
12078	Schumacher's Starch Feed	American Cereal Co.	Hartford, Cummings & Garvin
12135	Glen Cove Starch Feed	Nat'l Starch Mfg. Co.	New Haven, R. G. Davis
12188	Blatchford's Calf Meal	J. W. Barwell, Waukegan, Ill.	New Haven, R. G. Davis
12189	Pioneer Clover Meal	The Bennett & Millett Co., Gouverneur, N. Y.	New Haven, R. G. Davis
12198	Carob Bean		
12199	Carob Bean (Seeds)		
12200	Carob Bean (Hulls)		
11358	Animal Meal	Bowker Fertz. Co., Boston	Meriden, S. A. Billings
14013	Poultry Food	J. Lederer & Co., New Haven	
12896	Beef Scraps		New Haven, Abner Hendee

* Not a dealer.

SAMPLED IN 1899.

Station No.	Analyses. Water.	Ash.	Protein.	Fiber.	Nitrogen-Free Extract. (Starch. gum, etc.)	Ether Extract.	Price per ton.
12110	9.21	3.23	12.07	10.34	61.04	4.11	----
11399	10.28	3.64	13.25	10.19	58.59	4.05	$22.00
11362	10.38	1.95	12.87	9.10	61.80	3.90	22.00
12139	9.92	3.17	11.13	10.68	60.88	4.22	21.00
12145	10.51	2.98	11.63	10.43	59.98	4.47	24.00
12897	8.02	3.28	13.12	8.79	62.74	4.05	21.00
11580	10.35	2.91	12.62	9.51	60.58	4.03	21.00
11351	10.29	2.78	12.50	9.95	60.17	4.31	22.00
11588	10.40	3.47	12.06	11.63	58.64	3.80	21.00
	9.93	3.05	12.36	10.07	60.49	4.10	
	----	----	12.4	----	----	4.2	
	----	----	13.8	----	----	4.8	
	----	----	11 0	----	----	3.6	
12191	8.91	2.63	17.12	4.87	60.46	6.01	30.00
12898	8.00	3.01	17.75	4.91	60.66	5.67	33.00
11353	10.80	2.32	15.00	2.86	64.35	4.67	26.00
	9.23	2.65	16.62	4.21	61.84	5.45	
	----	----	17.5	----	----	5.5	
	----	----	19.5	----	----	6.0	
	----	----	15.0	----	----	4.7	
12072	11.75	3.69	14.81	2.97	63.95	2.83	20.00
12157	12.45	3.00	14.50	3.15	64.18	2.72	18.50
12130	12.17	3.03	14.25	2.92	64.74	2.88	18.00
12146	12.54	3.02	14.69	3.01	63.90	2.84	19.00
12905	8.67	3.44	14.50	2.70	68.08	2.61	22.00
12261	7.73	6.14	10.44	22.77	51.76	1.16	12.00†
12078	9.32	4.82	12.69	9.78	58.84	4.55	21.00
12135	11.20	0.54	21.13	3.15	60.73	3.25	19.00
12188	8.93	5.46	24.75	5.06	51.11	4.69	70.00
12189	8.36	6.76	9.50	28.28	44.68	2.42	40.00
12198	14.05	3.26	5.57	4.98	71.80	0.34	----
12199	12.84	3.27	15.00	7.16	59.90	1.83	----
12200	14.15	3.25	4.81	4.80	72.77	0.22	----
11358	6.20	41.43	36.94	----	4.18	11.25	40.00
14013	7.48	21.10	51.12	2.01	2.21	16.08	36.00‡
12896	7.64	17.90	49.12	3.79	5.29	16.26	35.00

† Car load lots delivered. ‡ Wholesale price.

Summary.

No cases of actual adulteration have been found among the samples examined.

A considerable number of these "feeds," notably most of the so-called "oat-feeds," are however of such inferior quality that they cannot be used to any profit.

It appears that the three most concentrated feeds, the three which, pound for pound, will go further in "balancing" or piecing out the ration made from home-grown feed, viz: cotton seed, linseed and Atlantic gluten meal, are the most costly. This is as it should be. Yet of these, the one which contains the most protein, "Atlantic gluten meal," is the cheapest. It does not follow that it should be bought to the exclusion of the others. Linseed meal, though a very expensive feed, is greatly relished by cattle, flavors the food and is generally regarded as an excellent thing to keep cows "in condition."

But evidently the wise feeder will endeavor to use the cheaper forms of protein, *as far as possible.*

An examination of the prices and analyses of the feeds given in the table also shows that the market prices bear very little if any relation to their feeding value. That is, "feed" costs from $17.00 to $20.00 per ton at retail, whether it is concentrated, rich in protein, and well suited to supplement the home-grown feed, or whether it is a starchy food and of much less value in compounding suitable cattle rations. In this condition of the market, special care in the purchase of feeds and some knowledge of their chemical composition will be found highly advantageous in keeping the cost of milk production down to a point which will admit of profit in the business.

ON THE AVAILABILITY TO GRASS OF NITROGEN IN FORM OF NITRATE OF SODA, COTTON SEED MEAL AND FINE, HARD BONE.

Season of 1899. (Second Year.)

By E. H. Jenkins and W. E. Britton.

These cultures are in continuation of those described in the Report of this Station for 1898, pages 289 to 296, which were begun in February, 1898.

The aim of the experiment is to study the availability of nitrogen in the forms named, to a crop which occupies the land permanently or for several seasons.

These cultures are in galvanized iron pots, wired on the upper edge, eight inches in diameter and twelve inches deep and having in cross section an area of about 1-125,000 of an acre. The bottom of each pot is slightly concave, and in the center is a hole with a collar three-fourths of an inch in diameter. The pot is supported on three iron legs, so that the lowest point of the collar is two and one-half inches above the platform on which the pot stands. These pots are like those used in experiments described in our earlier reports and before using were painted inside with two coats of asphalt varnish. The soil used was a very sandy loam from a field which, it was stated, had not been manured, fertilized, or cultivated for many years. Six determinations of nitrogen in samples taken from as many different parts of the heap of soil which had been screened, mixed and ready for use, gave the following percentages of nitrogen: 0.097, 0.100, 0.100, 0.099, 0.099, 0.098. Each pot contained twenty-nine pounds of soil and 13.022 grams of soil-nitrogen.

To the soil of each pot were added 9.5 grams of precipitated calcium carbonate (containing lime equal to one ton of slaked lime per acre), 1.8 grams of muriate of potash, equivalent to about 500 pounds per acre and 1.2 grams of precipitated phosphate of lime (containing phosphoric acid equal to that in about 1,000 pounds of acid phosphate per acre), besides the nitrogenous fertilizers, which were fine enough to pass circular holes one-fiftieth inch in diameter.

The quantities of nitrogen supplied to the soil of the several pots are given in Table I, page 200, and are equivalent to the following quantities of fertilizer per acre:

Nitrate of Soda,	461	lbs.	per acre, and	231	lbs.	per acre.
Cotton-seed Meal,	991	"	"	496	"	"
Bone,	1,990	"	"	995	"	"

The quantities of fertilizer-nitrogen were alike, whether applied in form of nitrate, cotton seed meal, or ground bone. In each pot were first placed fourteen pounds of the soil under experiment. With fifteen pounds of the soil were carefully mixed the fertilizers mentioned above, and this mixture was then filled into the pot, great pains being taken to pack the soil alike in all the pots of the series.

The pots, including a layer of gravel on the bottom, weighed five pounds each, and each received twenty-nine pounds of soil, equivalent to twenty-five pounds twelve ounces of water-free soil. The soil with 15.50 per cent. of water in it contained 70 per cent. of the moisture which it could hold if saturated, and with 11.60 per cent. of water in it the soil had 50 per cent. of what it could hold if saturated.

During the course of these experiments the moisture content of the soil was therefore allowed to sink to 11.6 per cent., and was then raised, by adding water, partly on the surface and partly at the bottom, to 15.50 per cent., as determined by frequent weighings.

Into each pot were transplanted three small sets, cut from a turf of common red-top. One dozen such sets as were used for this purpose contained 0.052 grams nitrogen. The pots were filled and planted Feb. 14th to Feb. 17th, 1898, and stood till June 10th in the greenhouse, having a temperature by day of about 60° F., and by night about 50° F. During the summer the pots were placed in the summer vegetation house, and brought into the greenhouse again in October.

The grass was cut whenever it reached a length of three or four inches, thus imitating the practice of grazing or lawn-mowing, and all the clippings were carefully saved.

In early summer nitrogen was determined in the three clippings which had been already made, again in the fall it was determined in the next three clippings, and in a seventh clipping made Jan. 7th, 1899.

The results of the first year's observation are given in a table on page 291 of the Station Report for 1898 and are there discussed.

Immediately after the seventh clipping, Jan. 7, 1899, the soil of the pots was allowed to dry till it contained but 11.6 per cent. of water. To each of the pots numbered 361, 362, 363 and 364 was added 0.8385 gram nitrate of soda; to each of the pots numbered 365, 366, 367 and 368 were added 1.8007 grams cotton seed meal, and to each of the pots numbered 370 and 371 were added 3.6308 grams of raw knuckle bone flour.

The above quantities of the three fertilizers named contained the same amount of nitrogen,—0.1333 gram,—and the fertilizers were from the same stock which had been used for these experiments in the previous year. In every case the material was spread as evenly as could be on the surface of the soil, which was immediately watered to bring the percentage of water in the soil to the maximum named above.

Of the pots which had received no nitrogenous fertilizer, 357, 358 and 359 had a rather thin stand of grass with much dead stubble, while the fourth, 360, was well covered.

All those pots to which nitrate had been added, 361, 362, 363 and 364, had a good thick turf and made fair growth.

Those pots which had received cotton seed meal, Nos. 365, 366, 367 and 368, were fairly well covered with turf, which was, however, not as close or thick as in the nitrate series.

The grass in pots 370 and 371 which had received bone had not well covered the surface but showed a short thin growth and much dead stubble.

In order to learn whether the first year's cropping had removed from the soil more potash and phosphoric acid than had been put on in the fertilizer, a number of determinations were made from which it appeared that the soil of the pots which had received most nitrate, had each lost by cropping 0.265 gram of phosphoric acid and 1.304 grams of potash. The other pots of the series had lost less of each of these. To each pot, at the beginning, had been added 1.8 grams of muriate of potash and 1.2 grams of precipitated dicalcium phosphate containing in all about 0.9 gram of potash and 0.498 gram of phosphoric acid. It being evident that more potash had been removed from some of the pots than had been added in the fertilizer,

the earth of the pots was again allowed to dry to the lower water limit, one gram of muriate of potash was added on the surface and the pots were watered on the surface to the upper water-limit.

The pots stood in the green-house till June 9th, when they were moved to the summer vegetation house. On November 13th they were brought again into the green-house for the winter.

The growth of grass was cut on March 8th, May 9th, and July 8th. These three cuttings were analyzed together. The grass was also cut on Aug. 9th, Sept. 11th and Nov. 24th, 1899, and these three later cuttings were also analyzed together.

The results appear in Table I.

TABLE I—ON THE AVAILABILITY TO GRASS OF NITROGEN IN NITRATE OF SODA, COTTON SEED MEAL AND FINE, HARD, RAW BONE. SEASON OF 1899.

Station No.	Crop.	Nitrogenous Fertilizer.	Equivalent pounds of fertilizer per acre.	Nitrogen per pot.	First three cuttings.		Second three cuttings.		Total Crop.	
					Air-dry weight, grams.	Nitrogen, grams.	Air-dry weight, grams.	Nitrogen, grams.	Air-dry weight, grams.	Nitrogen, grams.
357	Grass	Nothing	0.00	.0000	6.0	.1320	4.6	.1017	10.6	.2337
358	"	"	0.00	.0000	6.3	.1279	5.5	.1062	11.8	.2341
359	"	"	0.00	.0000	6.2	.1290	5.1	.1000	11.3	.2290
360	"	"	0.00	.0000	5.2	.1217	4.4	.0964	9.6	.2181
361	"	Nitrate of Soda	231	.1333	9.4	.2378	5.7	.1157	15.1	.3535
362	"	"	231	.1333	9.4	.2218	5.5	.1128	14.9	.3346
363	"	"	231	.1333	9.9	.2257	5.3	.1065	15.2	.3322
364	"	"	231	.1333	7.5	.2003	4.8	.1104	12.3	.3107
365	"	Cotton Seed Meal	496	.1333	7.5	.1770	4.4	.0968	11.9	.2738
366	"	"	496	.1333	8.4	.1772	5.2	.1134	13.6	.2906
367	"	"	496	.1333	6.9	.1615	4.1	.0877	11.0	.2492
368	"	"	496	.1333	7.6	.1740	4.5	.0968	12.1	.2708
370	"	Ground Bone	995	.1333	4.7	.1109	3.9	.0858	8.6	.1967
371	"	"	995	.1333	6.0	.1332	5.3	.1124	11.3	.2456

Discussion of the Results in 1899.

The grass in the four pots to which no nitrogenous matter has been added for two years, yielded during the second year

an average of 10.8 grams of air-dry crop and 0.2287 gram crop-nitrogen per pot.

The grass in the four pots to which 0.1333 gram of nitrate was added at the beginning of the second year yielded an average of 14.4 grams of air-dry crop and 0.3328 gram crop-nitrogen.

From which it appears that 0.1333 gram of fertilizer-nitrogen caused an increase of 3.6 grams air-dry crop and 0.1041 gram of crop-nitrogen over and above the yield of the unfertilized soil. This is a gain of one-third in the crop, and of the nitrogen added in the fertilizer, 78.1 per cent. was recovered in the crop, while 21.9 per cent. was either left in the soil, stubble and roots or escaped from them into the air.

The grass in pots which received 0.1333 gram nitrogen in form of cotton seed meal yielded an average of 12.15 grams of air-dry crop with 0.2711 gram of crop-nitrogen,—a gain over the crops from pots which received no nitrogenous fertilizer, of one-eighth,—12.5 per cent. Of the nitrogen of the fertilizer only 31.8 per cent. was recovered in the crop and 68.2 per cent. was retained in soil, stubble and roots or escaped from them into the air.

The grass in the two pots which received a top-dressing of 0.1333 gram nitrogen in form of hard, raw bone yielded on the average slightly less dry matter and nitrogen than was harvested from pots which received no nitrogenous fertilizer whatever. The difference is, however, insignificant.

Comparison of the Yields of 1898 and 1899.

In Table II is given a statement of the weights of air-dry crop and of crop-nitrogen harvested in the two years from the beginning of the experiment.

In 1898, 90 per cent. of the larger and 77.4 per cent. of the smaller applications of nitrate-nitrogen were recovered in the crops; in 1899, 78.1 per cent. of the nitrate-nitrogen were recovered.

In 1898 the larger amount of nitrate-nitrogen in the fertilizer increased the total crop by 31.7 per cent. and the smaller amount by 5.6 per cent.; in 1899 the increase was 33.3 per cent.

In 1898, 49.9 per cent. of the larger application of nitrogen as cotton seed meal, and 65.9 per cent. of the nitrogen of the smaller application were recovered in the crop; in 1899 only 31.8 per cent. It should be borne in mind that the fertilizers in 1898 were mixed with the soil, while in 1899 they were applied as a top dressing.

In 1898 the applications of cotton seed meal increased the crop by 6.3 and 2.1 per cent. respectively; in 1899 the increase was 12.5 per cent.

In 1899, as in 1898, the application of hard raw bone had absolutely no effect on the crop.

TABLE II—ON THE AVAILABILITY TO GRASS OF NITROGEN IN NITRATE OF SODA, COTTON SEED MEAL AND FINE, HARD, RAW BONE. (SUMMARY OF CROPS OF 1898 AND 1899.)

No. of Pot.	Nitrogenous Fertilizer.	Equivalent pounds per acre.		Nitrogen per pot.		Crop of 1898.		Crop of 1899.	
		1898.	1899.	1898.	1899.	Air-dry weight.	Grams nitrogen.	Air-dry weight.	Grams nitrogen.
357	Nothing	0.00	0.00	0.00	0.00	27.2	.7399	10.6	.2337
358	"	0.00	0.00	0.00	0.00	29.1	.7119	11.8	.2341
359	"	0.00	0.00	0.00	0.00	31.2	.7464	11.3	.2290
360	"	0.00	0.00	0.00	0.00	26.1	.7175	9.6	.2181
361	Nitrate of Soda	461	231	.2665	.1333	38.0	.9725	15.1	.3535
362	"	461	231	.2665	.1333	36.7	.9642	14.9	.3346
363	"	231	231	.1333	.1333	30.6	.8335	15.2	.3322
364	"	231	231	.1333	.1333	29.4	.8308	12.3	.3107
365	Cotton Seed Meal	991	496	.2665	.1333	30.9	.8648	11.9	.2738
366	"	991	496	.2665	.1333	29.5	.8588	13.6	.2906
367	"	496	496	.1333	.1333	28.7	.8058	11.0	.2492
368	"	496	496	.1333	.1333	29.2	.8276	12.1	.2708
370	Ground Bone	1990	995	.2665	.1333	27.7	7435	8.6	.1967
371	"	995	995	.1333	.1333	25.5	6957	11.3	.2456

In general the weights of air-dry crops in 1899 are between one-half and one-third as large as the corresponding ones in 1898, and the crop-nitrogen of 1899 is about one-third that of 1898.

The soil of each pot contained at the beginning of the experiment more than 13 grams of nitrogen, exclusive of what was added in the fertilizers. Of this, the crops in the pots receiving no fertilizer-nitrogen have taken off less than 1 gram, yet if to this soil containing more than 12 grams of soil-nitrogen,

we add 0.1333 gram of nitrate-nitrogen, or about one one-hundredth part of what is already in the soil (but in inert form), the yield of the crop is increased by one-third.

These facts well illustrate the inertness of the soil-nitrogen and the fact that an amount of nitrogen too small to be certainly detected in the soil by chemical means, may yet make all the difference between a good crop and a poor one.

Present condition of the grass in these cultures.

Pots 257, 258, 259 and 260 have a rather thin sod and some moss in each pot.

261 and 264 are fairly well covered with sod.

262 and 263 are not well covered, but better than 257-260.

265, 266, 267, 268 are as well covered with sod as any of the preceding. Moss in all of them.

270 not half covered with sod. 271 very mossy, not more than half covered with sod.

The soils in the pots tested with sensitive litmus paper do not have an acid reaction. Three which were tested with lacmoid, 370, 371 and 367, gave a slight alkaline reaction.

The cultures are being continued.

Summary.

The yields in 1899 were without exception much less than in 1898. This may have been due to a lack of available potash in the second year, to difference in the amount of sunlight, or to possible change in the mechanical condition of the soil, caused by the watering.

The important fact brought out by the cultures is that in this soil and under the conditions of our experiment, while the nitrogen of nitrate of soda and cotton seed meal very largely increased the crop and the crop-nitrogen, the nitrogen of fine hard raw knuckle bone had absolutely no effect of this kind.

There is no evidence that the fertilizer-nitrogen of hard raw bone, applied two years ago, has yet been assimilated in any amount by grass which has been growing continuously in the soil with it.

We do not assert that the nitrogen of this bone is not available to crops, but only that in this soil and under the conditions described in this paper, it has not been available.

ON THE AVAILABILITY TO HUNGARIAN GRASS OF NITROGEN IN FORM OF NITRATE OF SODA, COTTON SEED MEAL AND RAW, BOILED AND STEAMED BONE.

POTS 373 TO 442. (SEASON OF 1899.)

BY E. H. JENKINS AND W. E. BRITTON.

Cultures made by us in 1896, Report of this Station for 1896, page 204, in a sandy loam from under turf, showed that, under the conditions there specified, fine raw bone flour, which passed fine bolting cloth, was about one-third as efficient a source of nitrogen to the maize crop as cotton seed meal, and that coarser grades of the same kind of bone supplied but very little nitrogen to this crop.

In 1897, Report of this Station, 1897, page 270, cultures of oats followed by Hungarian grass were made in a sandy loam taken from a field on which maize had grown for six years without fertilizers or manure. In these tests the nitrogen of raw knuckle bone, the particles of which passed circular holes $^1/_{50}$ inch in diameter, had only one-sixth of the availability of the nitrogen of nitrate, and one-quarter of that of linseed, cotton seed, caster pomace, steamed horn and hoof, etc. In the same report, page 277, are described cultures made in the same kind of soil as those just referred to, using Hungarian grass as a crop. It appeared from these cultures that while 95.3 per cent. of the nitrogen of nitrate of soda and 57.9 per cent. of that of cotton seed meal were taken up by the crop, under like conditions only 11.3 per cent. of the nitrogen of the finest bone flour—made from hard, raw knuckle bone—was taken by the crops, and still less than that percentage from coarser grades of bone. These experiments, as well as those extending over two years, described on pages 197 to 203 of this Report, in which a perennial crop was used, show that under the conditions of our tests the nitrogen of raw knuckle bone, even when the bone is very fine, is not readily nor satisfactorily available to either maize, oats, Hungarian or red top grass.

In the tests now to be described, it was sought to learn whether, under like conditions, the nitrogen of soft raw bone,

and of steamed and boiled bone, was more available to plants than that of hard raw bone.

The vegetation pots used were precisely like those already described in this Report, page 197.

The light sand soil with which they were filled came from a field which the owner stated had not been manured, fertilized or cultivated for many years.

Twelve samples of this soil, containing 12.77 per cent. of water, taken at different times during the charging of the pots and from different parts of the heap of sifted and well-mixed soil, contained the following percentages of nitrogen: 0.106, 0.109, 0.110, 0.109, 0.108, 0.112, 0.106, 0.114, 0.109, 0.113, 0.110, 0.110. The average of all determinations is 0.1095 per cent. of nitrogen. The soil itself had a faint acid reaction to litmus paper.

With 18.23 per cent. of moisture in it the soil had 70 per cent. of the water it could hold when saturated. With 13.74 per cent. of moisture in it, it had 50 per cent. of its water-holding capacity. Each pot when ready for filling weighed alike, the same quantity of soil (30 pounds, containing 12.77 per cent. of water) was put into each, and by frequent weighing and watering when necessary the water content of the soil was kept between 13.74 and 18.23 per cent.

The operations of charging the pots were carried out as described an page 198.

To the soil for each pot were added 6.6 grams of freshly slaked lime, free from magnesia, 1.8 grams of muriate of potash (48.54 per cent. of potash) and 1.2 grams of dicalcium phosphate containing 41.50 per cent. of phosphoric acid besides the nitrogenous fertilizers named in Table IV.

The nitrogenous fertilizers tested were the following: nitrate of soda with 16.08 per cent. of nitrogen, cotton seed meal with 8.42 per cent. of nitrogen, hard raw knuckle bone,—sawings, and scraps from "ivory goods," made by the Rogers & Hubbard Co. of Middletown,—the same article used in the experiments described on page 197, containing 4.16 per cent. of nitrogen, soft raw bone containing 3.98 per cent., boiled bone containing 2.77 per cent., and steamed bone containing 2.31 per cent. of nitrogen, sent to us by Lister Fertilizer and Chemical Works, and representing grades of bone now in market.

All of these materials were ground to pass circular holes $^1/_{50}$ inch in diameter.

On June 7th, twenty seeds of Hungarian grass were planted in each pot at a depth of about one-half inch, and the soil was watered up to 70 per cent. of its water-holding capacity. By the 10th the young plants began to appear and on the 20th they had appeared in all the pots.

On June 29th the plants were about eight inches high and beginning to stool in most of the pots. On Aug. 20 the crops were harvested, the seed being ripe and likely to drop if cutting was longer delayed.

The surface soil was loosened and the root system was pulled up as well as could be with the stalks. The roots, stalks, leaves and heads were ground together, making one sample of all the plants from each pot.

On Aug. 25 the pots were planted to rye.

Table IV, page 209, gives the results from the crop of Hungarian grass.

Discussion of the results.

Cultures in pots numbers 373 to 382 received no fertilizer-nitrogen and show the capacity of the soil-nitrogen for supporting plant production.

The air-dry crops in these pots ranged in weight from 36.5 to 43.4 grams and averaged 40.44 grams, while the crop-nitrogen ranged from 0.2691 to 0.3207 gram and averaged 0.2932 gram. That is, of the 14.91 grams of nitrogen contained in the soil of these pots only about two per cent. was available to the first crop.

Five pots, numbers 383 to 387, received 0.2664 gram of fertilizer-nitrogen in form of nitrate of soda. In these pots the weight of the air-dry crop averaged 59.16 grams and the crop nitrogen averaged 0.5035 gram. Subtracting from these the corresponding weights from pots which received no fertilizer-nitrogen, there is left 18.72 grams of air-dry crop and 0.2103 gram of crop-nitrogen, which represent the fertilizer effect of the 0.2664 gram of nitrate of soda. That is, on this soil, nitrate of soda, at the rate of about 460 lbs. per acre, increased the crop by 46 per cent., and 78.9 per cent. of the fertilizer-nitrogen was recovered in the crop.

The next five pots in the series received half as much fertilizer-nitrogen as those just mentioned, in form of nitrate of soda. The average weight of air-dry crop from these five pots was 50.64 grams and of crop-nitrogen 0.3775 gram. Subtracting, as before, the corresponding weights from pots which received no fertilizer-nitrogen, there is left 10.2 grams of air-dry crop and 0.0823 gram of crop-nitrogen, which represent the effect of the fertilizer-nitrogen.

That is, on this soil, nitrate of soda, put on as a fertilizer at the rate of 230 pounds per acre, increased the yield of Hungarian by 25.2 per cent.; and of the nitrogen applied to the soil 62 per cent. was recovered in the crop.

In like manner may be calculated the percentage crop-increase and the percentage of the fertilizer-nitrogen recovered in the crop for each of the fertilizers used. These results are given in the following:

TABLE III.—PERCENTAGES OF CROP-INCREASE AND OF FERTILIZER-NITROGEN RECOVERED IN THE CROPS.

Fertilizer per acre.		Crop-increase.	Fertilizer-Nitrogen recovered in crop.
Nitrate of soda	462 pounds	46	79
"	231 "	25	62
Cotton seed meal	871 "	28	38
"	436 "	18	44
Hard raw bone	1760 "	—1.7	1.3
"	880 "	0.7	—26.6
Soft raw bone	1840 "	16.3	8.8
"	920 "	4.3	10.0
Steamed bone	3170 "	19.1	8.5
"	1585 "	4.8	—13.9
Boiled bone	2650 "	5.3	—1.2
"	1325 "	3.0	—32.3

Inspection of these figures shows that from sixty-two to seventy-nine per cent. of the fertilizer-nitrogen in form of nitrate of soda and from thirty-eight to forty-four per cent. of the fertilizer-nitrogen in form of cotton seed meal were available and taken up by the crop.

The results where bone-nitrogen was applied are very irregular and much less nitrogen was present in some crops which had grown in pots to which bone was added as a fertilizer than

in crops from pots which had no fertilizer-nitrogen added to them. In no case where bone was used as a fertilizer did more than about eight and a half per cent. of the fertilizer-nitrogen become available to the crop. In every case the larger application of bone had a better effect than the smaller one.

The cause of the irregularities, especially in the yields of nitrogen, are not apparent.

The weight of air-dry crop was not sensibly increased by the hard raw bone and the increase from boiled bone was small, but the larger applications of both soft raw bone and of steamed bone very noticeably increased the yield of air-dry crop.

In general it appears that soft raw bone and steamed bone have increased the weight of crop, while raw bone had no such effect and boiled bone but very slight effect.

The larger doses of nitrogen from steamed bone and soft raw bone increased the crop-nitrogen by about eight per cent., while the larger doses of nitrogen from raw bone and boiled bone did not increase the crop-nitrogen.

Where the smaller doses of bone-nitrogen were used in each case less nitrogen appeared in the crop than where no fertilizer-nitrogen was employed.

TABLE IV—AVAILABILITY OF NITROGEN OF NITRATE, COTTON SEED MEAL, AND RAW HARD BONE, RAW SOFT BONE, AND STEAMED AND BOILED BONE. CULTURES OF HUNGARIAN GRASS. SEASON OF 1899.

No. of Pot.	Nitrogenous Fertilizer.	Amount of Nitrogenous Fertilizer.			Air-dry crop. Weight in grams.	Grams of crop-nitrogen.
		Equivalent pounds per acre.	Grams of fertilizer per pot.	Grams of fertilizer-nitrogen per pot.		
373	Nothing	----	----	----	36.5	.2847
374	"	----	----	----	41.2	.2719
375	"	----	----	----	42.2	.3207
376	"	----	----	----	43.4	.3038
377	"	----	----	----	39.9	.2793
378	"	----	----	----	37.8	.2873
379	"	----	----	----	41.4	.2691
380	"	----	----	----	40.3	.3023
381	"	----	----	----	40.0	.3040
382	"	----	----	----	41.7	.3086
383	Nitrate of Soda	462	1.657	.2664	58.0	.5510
384	" "	462	1.657	.2664	61.2	.5569
385	" "	462	1.657	.2664	60.1	.4568
386	" "	462	1.657	.2664	60.7	.5342
387	" "	462	1.657	.2664	55.8	.4185
388	" "	231	0.829	.1332	49.4	.4051
389	" "	231	0.829	.1332	50.9	.3410
390	" "	231	0.829	.1332	50.2	.3765
391	" "	231	0.829	.1332	51.2	.3481
392	" "	231	0.829	.1332	51.5	.4068
393	Cotton Seed Meal	871	3.165	.2664	53.1	.3983
394	" " "	871	3.165	.2664	51.9	.4256
395	" " "	871	3.165	.2664	50.7	.3752
396	" " "	871	3.165	.2664	51.0	.3417
397	" " "	871	3.165	.2664	51.1	.4292
398	" " "	436	1.583	.1332	50.2	.3865
399	" " "	436	1.583	.1332	46.6	.3542
400	" " "	436	1.583	.1332	48.1	.3271
401	" " "	436	1.583	.1332	45.0	.3420
402	" " "	436	1.583	.1332	49.5	.3465
403	Hard Raw Bone	1760	6.426	.2664	37.9	.2843
404	" " "	1760	6.406	.2664	37.6	.2632
405	" " "	1760	6.406	.2664	44.0	.2992
406	" " "	1760	6.406	.2664	37.8	.3137
407	" " "	1760	6.406	.2664	41.4	.3229
408	" " "	880	3.203	.1332	38.5	.2657
409	" " "	880	3.203	.1332	40.1	.2566
410	" " "	880	3.203	.1332	43.7	.2578
411	" " "	880	3.203	.1332	39.5	.2252
412	" " "	880	3.203	.1332	41.7	.2836

TABLE IV—CONTINUED.

No. of Pot.	Nitrogenous Fertilizer.	Amount of Nitrogenous Fertilizer.			Air-dry crop. Weight in grams.	Grams of crop-nitrogen.
		Equivalent pounds per acre.	Grams of fertilizer per pot.	Grams of fertilizer-nitrogen per pot.		
413	Soft Raw Bone	1840	6.696	.2664	50.5	.3384
414	" " "	1840	6.696	.2664	42.8	.2996
415	" " "	1840	6.696	.2664	47.4	.2844
416	" " "	1840	6.696	.2664	47.0	.3384
417	" " "	1840	6.696	.2664	47.6	.3237
418	" " "	920	3.348	.1332	40.8	.2489
419	" " "	920	3.348	.1332	42.8	.2568
420	" " "	920	3.348	.1332	44.2	.2652
421	" " "	920	3.348	.1332	42.6	.2854
422	" " "	920	3.348	.1332	40.6	.2761
423	Steamed Bone	3170	11.537	.2664	49.1	.3339
424	" "	3170	11.537	.2664	51.5	.3296
425	" "	3170	11.537	.2664	46.5	.3162
426	" "	3170	11.537	.2664	44.1	.2911
427	" "	3170	11.537	.2664	49.7	.3081
428	" "	1585	5.768	.1332	43.6	.2965
429	" "	1585	5.768	.1332	43.5	.2784
430	" "	1585	5.768	.1332	40.2	.2693
431	" "	1585	5.768	.1332	42.9	.2703
432	" "	1585	5.768	.1332	41.7	.2585
433	Boiled Bone	2650	9.621	.2664	44.3	.2747
434	" "	2650	9.621	.2664	42.3	.2707
435	" "	2650	9.621	.2664	41.7	.2919
436	" "	2650	9.621	.2664	41.2	.3090
437	" "	2650	9.621	.2664	43.4	.3038
438	" "	1325	4.810	.1332	40.3	.2499
439	" "	1325	4.810	.1332	39.0	.2574
440	" "	1325	4.810	.1332	41.8	.2549
441	" "	1325	4.810	.1332	44.2	.2343
442	" "	1325	4.810	.1332	43.1	.2543

ON THE AVAILABILITY OF THE NITROGEN OF HARD RAW BONE AS AFFECTED BY APPLICATIONS OF SLAKED LIME.

POTS 443 TO 467. (SEASON OF 1899.)

BY E. H. JENKINS AND W. E. BRITTON.

As noted on page 204 of this Report, we have already made several series of cultures in which was tested the availability of nitrogen in hard raw bone of various degrees of fineness to Red-top and Hungarian grasses, oats, rye and maize. In none of these cultures was the fertilizer-nitrogen of the bone available to the extent of more than about 12 per cent., while under the same conditions the nitrogen of nitrate of soda was freely available as well as that of cotton seed meal.

Soils from three different places were used in these experiments, but the three were of the same general character; rather light sandy loams deficient in available plant food, *i. e.*, having little "natural fertility." They were naturally "leachy" and liable to suffer from drought more than heavier soils, but in these cultures, they contained at all times a sufficient water supply (from 50 to 70 per cent. of the water-holding capacity of the soil).

The soils in these cultures had sufficient available potash, phosphoric acid and other ingredients of plant food to produce a much larger crop than was harvested; available nitrogen was therefore the one thing lacking and in none of the cultures did hard raw bone supply it in any considerable quantity.

It remained to see whether anything could be added to the soil which would render the nitrogen of raw bone available within it.

Naturally lime was first tried, because its effect in "unlocking fertility" has long been known and commented upon in agricultural writings.

In our experiments in 1896, referred to on page 204, each pot received 10 grams of precipitated calcium carbonate, equivalent to 1,850 pounds of carbonate or 1,036 pounds of oxide of lime per acre.

In the two series of experiments referred to on pages 259 to 270 and pages 271 to 277 of our Report for 1897 (made in small pots), 50 grams of precipitated calcium carbonate were mixed with the soil of each pot, equivalent to 13,700 pounds of carbonate or 7,700 pounds of oxide of lime per acre.

In the experiments referred to on pages 197 to 203 of the present Report, 9½ grams of precipitated calcium carbonate were added to the soil of each pot, equivalent to 2,600 pounds of carbonate or 1,460 pounds of oxide of lime per acre.

Lime in form of carbonate therefore has not made available the nitrogen of the bone.

In the cultures now to be described was tested the effect of freshly slaked hydrate of lime.

The pots used were in all respects like those described on page 197. The glass tubes for ventilating and watering were a little larger, having an inside diameter of one-half inch.

The pots were brought to a uniform weight of five pounds by putting in gravel. The soil was taken from the same heap from which the pots in the series just described, pages 204 to 210, were charged. Fourteen pounds of this soil containing 15.69 per cent. of moisture was put in each pot on June 29th.

On July 3d the fertilizers for each pot were carefully mixed with 16 pounds of the soil, which at the time contained 14.7 per cent. of moisture, and the mixture filled into the pot. Twenty seeds of Hungarian grass were placed equi-distant on the leveled surface of this soil and covered one-half inch deep.

To the soil of each pot in the series were added 1.8 grams muriate of potash (.8737 gram potash), 1.2 grams di-calcium phosphate and 6.4 grams of fine hard knuckle bone (No. 12201) containing 4.16 per cent. of nitrogen, or 0.2662 gram nitrogen).

To pots Nos. 443 to 447 inclusive no lime was added.

Pots 448 to 452 received 6.6 grams; pots 453 to 457 received 13.2 grams; pots 458 to 462 received 19.8 grams and pots 463 to 467 received 26.4 grams of freshly slaked but dry lime containing only traces of magnesia.

The largest dose of slaked lime is equivalent to 0.23 per cent. of the dry matter of the soil or 0.17 per cent. of calcium oxide.

The equivalent lime per acre is shown in Table V, page 216. The pots were placed in the summer vegetation house and the

water content of the soil was kept by frequent weighing and watering between 70 and 50 per cent. of the water-holding capacity of the soil.

The plants grew thriftily without accident. During July the plants in soil to which no lime had been added were strikingly taller than the others, which matured more slowly. By August 12th plants in all the pots had headed. On August 31 the plants in pots 443 to 452 were nearly ripe. Those in pots 453 to 457 were still green and had much longer and larger heads than the plants in pots to which no lime was added.

These differences are well shown by Figure 2 of the plate opposite page 216. The heads at the left grew on soil which received no lime; those on the right grew on soil dressed with lime at the rate of 3½ tons per acre; those in the center grew on soil dressed with 1¼ tons of lime per acre.

On September 18 the stalks and leaves were cut off, the heads having been previously cut as they ripened. The surface soil was loosened and the stubble with adhering roots was pulled out.

The average lengths of the stalks with their heads at harvest were as follows:

	Inches.
Where no lime was applied	42.4
1800 pounds of lime per acre	42.0
3600 " " "	41.8
5400 " " "	41.0
7200 " " "	41.4

The heads were weighed in air-dry condition and nitrogen determined in them. The stalks, leaves, stubble and roots from each pot were dried together and the percentage of nitrogen determined in them.

The results appear in Table V, page 216.

Discussion of the Results.

A comparison of the cultures in pots 448 to 457 with those in pots 403 to 407, see page 209, is instructive.

These two sets of cultures were in pots of the same size and shape, filled with soil from the same thoroughly mixed and uniform heap—the quantity of soil was larger by 11½ ounces in the series 403 to 407—the fertilizers and the quantity

of lime added was the same in all cases, the planting, watering and care were alike and the seed was from one common stock. The only apparent difference between the two was that the series 403 to 407 was planted on June 7th with 20 seeds of Hungarian grass and harvested August 20th, while the series 448 to 452 was planted on July 3d and harvested on September 18th.

Following is a comparison of the average yields per pot:

	Air-dry Crop. grams.	Nitrogen of Crop. grams.
Pots 403–407	39.7	0.2967
" 448–452	43.4	0.3112
Difference	3.7	.0145

The cultures planted in July yielded about 10 per cent. more of air-dry crop and 5 per cent. more of nitrogen than those planted early in June.

This difference is probably due to the more favorable conditions as to heat under which the cultures 448 to 452 made their early growth.

A study of the table on page 216 shows that the yields of air-dry crop and of crop-nitrogen were fairly uniform in the five pots of each group which represented a different dose of lime, the difference in crop-nitrogen of any one yield from the average of the five being in the extreme case 8 per cent. and in most cases much less.

The average yields per pot in each series may be summarized as follows:

		Total Crop. grams.	Crop-Nitrogen. grams.
No lime added	Nos. 443–447	51.9	0.3606
6.6 grs. lime added	" 448–452	43.4	0.3112
13.2 " " " "	453–457	46.9	0.3988
19.8 " " " "	458–462	57.9	0.4979
26.4 " " " "	463–467	58.3	0.5559

Summary.

1. An application equal to 1,800 pounds of slaked lime per acre decreased the yield of grain by 11 per cent., of straw (including roots and stubble) by 19 per cent., and of crop-nitrogen by about 14 per cent.

2. An application equal to 3,600 pounds of slaked lime per acre, instead of further decreasing the yield, increased the yield of grain by 13 per cent. and of crop-nitrogen by 10 per cent., while the yield of straw and stubble was 14 per cent. less than where no lime was applied.

3. Applications equal to 5,400 and 7,200 pounds of slaked lime per acre increased the crop as follows:

PERCENTAGE INCREASE OVER CROPS FROM SOIL TO WHICH NO LIME WAS ADDED.

		5400 pounds of lime per acre.	7200 pounds of lime per acre.
Per cent. increase of	grain	36.8	43.7
" "	straw*	1.2	1.9†
" "	crop-nitrogen	38.1	54.1

In these cultures, therefore, in which hard raw bone was used as a fertilizer, applications of large quantities of slaked lime (two and three times as much lime as bone) increased the grain in the crop by 36 to 44 per cent. and the crop-nitrogen by 38 to 54 per cent. over the yield from pots to which no slaked lime was added; but the yield of straw was not increased by the use of lime. From this series alone cannot be calculated the actual percentages of the fertilizer-nitrogen recovered in the crop, for the yield of crop-nitrogen from the soil without fertilizer is not determined nor the effect of the lime in making the soil-nitrogen available. Further experiments are being made on these points. These cultures, however, prove that slaked lime has made very much more available the nitrogen of the soil, or more probably, the nitrogen of the bone which without lime was almost inert as a fertilizer.

* Includes roots and stubble. † Decrease.

TABLE V.—EFFECT OF LIME ON THE AVAILABILITY OF HARD RAW BONE. CULTURES OF HUNGARIAN GRASS.

No. of Pot.	Quantity of Lime* added to pot, grams.	Equivalent Slaked Lime per Acre, pounds.	Weight of Air-dry Heads, grams.	Nitrogen in Heads, grams.	Weight of Air-dry Stalks and Roots, gms.	Nitrogen in Stalks and Roots, grams.	Total Air-dry weight of Crop, grams.	Total Nitrogen of Crop, grams.
443	None	None	14.6	.1986	37.5	.1538	52.1	.3524
444	"	"	17.3	.2232	36.1	.1444	54.4	.3676
445	"	"	15.7	.1963	35.3	.1447	51.0	.3410
446	"	"	15.7	.2198	37.5	.1575	53.2	.3773
447	"	"	14.7	.2308	34.3	.1337	49.0	.3645
448	5.0	1800	14.8	.2072	28.6	.1115	43.4	.3187
449			13.6	.1863	30.4	.1216	44.0	.3079
450			13.5	.1809	29.5	.1239	43.0	.3048
451			13.8	.1960	28.7	.1177	42.5	.3137
452			13.8	.1960	30.2	.1148	44.0	.3108
453	10.0	3600	16.8	.2386	33.4	.1403	40.2	.3789
454			17.9	.2578	30.9	.1483	48.8	.4061
455			19.2	.2784	30.0	.1350	49.2	.4134
456			17.8	.2599	30.6	.1346	48.4	.3945
457			18.4	.2742	29.5	.1269	47.9	.4011
458	15.0	5400	20.9	.3198	37.3	.1790	58.2	.4988
459			21.9	.3351	34.8	.1670	56.7	.5021
460			21.2	.3074	37.2	.1711	58.4	.4785
461			19.9	.3144	34.2	.1710	54.1	.4854
462			22.8	.3511	39.4	.1734	62.2	.5245
463	20.0	7200	21.8	.3444	35.9	.1687	57.7	.5131
464			20.7	.3830	28.8	.1987	49.5	.5817
465			24.1	.3904	34.2	.1915	58.3	.5819
466			23.3	.3658	36.5	.1898	59.8	.5556
467			22.2	.3331	42.0	.2142	66.2	.5473

* CaO in form of $Ca(OH)_2$.

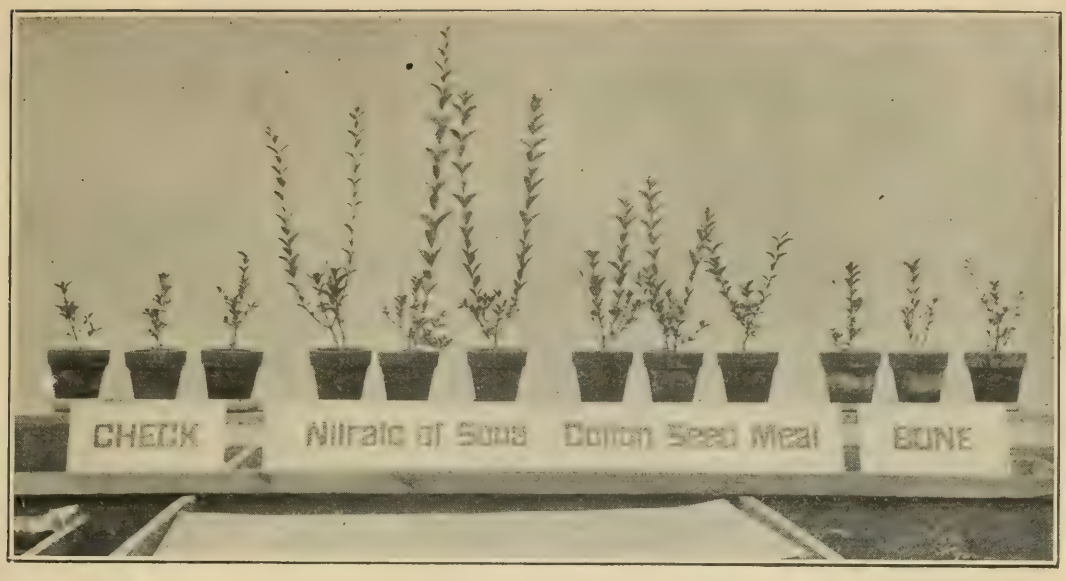


FIGURE I. California Privet with Various Nitrogenous Manures.
See page 217.



FIGURE II. Heads of Hungarian Grass.
See page 213.

AN OBSERVATION OF THE EFFECTS OF NITROGENOUS FERTILIZERS ON CALIFORNIA PRIVET.

By W. E. Britton.

In connection with the propagation of California privet (*Ligustrum ovalifolium*), for use as a hedge, a single observation was made on the fertilizing effect of nitrogen in form of nitrate, cotton seed meal and ground bone. Five dozen plants of nearly equal size, grown from cuttings of the previous spring, after washing the soil from their roots, were potted off in five-inch standard flower pots.

The soil into which they were thus transplanted was extremely sandy, consisting largely of disintegrated red sandstone and practically free from humus. It was screened through a sieve with four meshes to the inch. With the 1,300 grams of this soil used in each pot were mixed one gram of carbonate of lime, 0.8 gram of dissolved bone black and 0.4 gram muriate of potash. No nitrogen was added to the soil used for twelve of the pots. But to the soil for each of the other pots was added 0.2 gram of nitrogen.

In each of twelve, the nitrogen was in form of sodium nitrate, in twelve others in form of cotton seed meal and in twelve others in form of fine hard raw bone.

The pots were watered on the surface in the usual way, but glazed saucers were placed beneath them to prevent loss by leaching and about a month after setting the plants began to grow.

The potting was done in December, 1898, some of the plants blossomed in the summer of 1899, and in October the test was discontinued.

The plants in soil to which nitrate had been added were much larger than any others, and the foliage was of a darker green color. Those in soil to which cotton seed meal was applied made only a fair growth, while the effect of the bone fertilizer was scarcely apparent.

Figure 1 of the plate facing page 216, prepared from a photograph, well shows the growth caused by the different forms of nitrogen. The plants marked "check" had received phosphoric acid and potash, like the others, but no nitrogenous fertilizer.

Check plants	7 to 10	inches high.
Plants with nitrate	24 to 30	"
" cotton seed meal	15 to 16	"
" fine raw bone	9 to 10	"

While this observation has no importance in fixing the relative agricultural value of the several forms of nitrogen, it is a striking illustration of the differences of effect of the several nitrogenous fertilizers with the soil and the plant under experiment.

ON THE USE OF COMMERCIAL FERTILIZERS FOR FORCING HOUSE CROPS.

By E. H. Jenkins and W. E. Britton.*

The work here described is a continuation of the experiments begun in 1894, the results of which have appeared in the Reports of this Station for 1895, pp. 75 to 98; 1896, pp. 205 to 221, and for 1897, pp. 278 to 308.

I. EXPERIMENTS WITH TOMATOES. SUMMARY OF THE WORK EXTENDING OVER FIVE YEARS, 1894–1899.

Beginning with the season of 1894–1895, experiments have been conducted each season with soils and fertilizers for growing tomatoes under glass. One crop was grown the first season and two crops each of the other seasons, making nine crops in all. The results and chief points of interest are given in this paper.

Crop of 1894–1895.

[Report for 1895, page 90.]

1. It was found that tomatoes which were normal in size, color, taste, and chemical composition could be grown in a soil of coal ashes and peat moss by the aid of fertilizer chemicals. A yield of two or more pounds per square foot of bench space can be obtained in this way, such a crop taking up in vines and fruit, fertilizer ingredients at least equal to the following:

	Grams.			Pounds.	Ounces.
Nitrogen	168	equivalent to	Nitrate of Soda	2	5
Phosphoric Acid	65	"	Dissolved Bone Black	0	13
Potash	362	"	Muriate of Potash	1	9

Nearly four-fifths of this fertilizer went into the fruit.

2. From the weights and chemical analyses of the ripe fruits it was found that each 100 pounds of tomatoes removed from the soil approximately:

	Ounces.			Ounces.
Nitrogen	2.2	equivalent to	Nitrate of Soda	14
Phosphoric Acid	0.9	"	Dissolved Bone Black	5
Potash	4.6	"	Muriate of Potash	10

*The experiments in this series have been planned and this paper prepared conjointly by the authors. The cultural work has been done by Mr. Britton. All the chemical work involved has been done by Messrs. Winton, Ogden and Mitchell.

3. Plants grown in the soil of coal ashes and peat moss without the addition of fertilizers produced only one or two very small tomatoes each.

4. Of the three varieties, Acme, Ignotum and Dwarf Champion, the first gave the largest yield in the soil of coal ashes and peat, while Ignotum yielded best in compost. Dwarf Champion proved an unprofitable variety.

5. The tendency to bear double flowers which produce irregular shaped fruit, seemed to bear no relation to the quantity of fertilizers applied, soil, or to the variety. The same plant produced both single and double blossoms.

Crop of 1895–1896.

[Report for 1896, page 220.]

6. This season two crops of the Lorillard variety were grown, plants being set in the benches about October 1st for the first crop and February 14th for the second crop. With equal amounts of fertilizers the first crop was only seven-tenths as large as the second on account of less sunlight during the short days of early winter.

7. The largest quantities of nitrogen, phosphoric acid and potash taken by any one crop (Plot 30, Feb. to July, 1896) per 100 square feet of bench space were as follows:

	Grams.		Pounds.	Ounces.	
Nitrogen	226	equivalent to	3	10	Nitrate of Soda.
Phosphoric Acid	74	"	1	0	Dissolved Bone Black.
Potash	391	"	1	12	Muriate of Potash.

Less than two-thirds of these fertilizer ingredients were contained in the fruit. Of course much larger quantities should be present in the soil.

8. With the larger quantities of fertilizer chemicals used on the plots this year, larger amounts of nitrogen, phosphoric acid and potash entered into the composition of the fruit. Every 100 pounds of ripe tomatoes took from the soil:

	Ounces.		Ounces.	
Nitrogen	2.9	equivalent to	18.2	Nitrate of Soda
Phosphoric Acid	1.2	"	7.5	Dissolved Bone Black.
Potash	5.0	"	10.	Muriate of Potash.

9. By the use of fertilizer chemicals, and a soil composed of anthracite coal ashes mixed with three per cent. of peat moss

there was no difficulty in growing a larger crop of tomatoes than could be obtained from a rich compost either with or without the addition of fertilizer chemicals.

10. During the ripening season the quantities harvested each week were somewhat more uniform from the compost. Two-fifths of the whole crop from the coal ashes and peat was harvested within one week.

11. Roots growing in coal ashes and peat were free from nematode galls, while those in compost were somewhat affected.

Crops of 1896–1897.

[Report for 1897, page 293.]

Two crops of Lorillard tomatoes were grown in compost and in a soil composed of bituminous coal ashes and peat. The results of the tests may be summarized as follows:

12. The yield from compost was larger where no fertilizer chemicals were used. The addition of chemicals seemed to depress the yield.

13. From a mixture of bituminous coal ashes and peat with fertilizer chemicals added, larger crops were produced than from a rich compost of turf and manure.

14. Tomatoes are much more productive when grown in a mixture of coal ashes and peat than when grown in coal ashes without the peat.

15. In the tests here reported, the plants growing in compost yielded more fruit during the first month of the ripening season than those in the ashes and peat. From then on the weekly yield was largest from the plots of coal ashes and peat.

16. There seems to be no great difference in value between anthracite and bituminous coal ashes when mixed with peat and used as a soil for growing tomatoes.

17. The best yields of tomatoes were obtained from the soil of coal ashes and peat to which had been added per 100 square feet of bench space:

6.4 pounds of Nitrate of Soda.
1 " Dissolved Bone Black.
2.4 " Muriate of Potash.

The amounts of fertilizer chemicals which can be used with profit depends on the season of the year in which the crop is

raised. The crop which is in the house from September to February will not bear as much fertilizer as the following one growing from February to July, on account of the smaller amount of sunlight in the first period which the plants can utilize.

18. Plants which received large quantities of freely soluble plant food in the soil of coal ashes and peat had much less extensive root systems than those in the same soil less heavily fertilized or in compost, and when full grown, wilted more easily.

Crops of 1897–1898.

[Hitherto unpublished.]

In this season two crops were grown. The plants were of the Lorillard variety for the first crop and for the second Lorillard, Acme, and Essex Hybrid were used, two plants of each being set in each plot. The compost and coal ashes plots were made to alternate with each other throughout the house. To each plot of coal ashes and peat were added:

65	grams	Nitrate Nitrogen	from	411.64	grams	of Nitrate of Soda.
50	"	Organic "	"	700.	"	Cotton Seed Meal.
24	"	Phosphoric Acid	"	141.36	"	Dissolved Bone Black.
100	"	Potash	"	215	"	Muriate of Potash.

For the second crop the quantities of fertilizers removed by the first crop were replaced. The plants were positively injured as a result of the large quantities of fertilizers and small yields were obtained. The chief points of interest in the trials are as follows:

19. Quantities of fertilizer chemicals consisting of

	Ounces.		Pounds.	Ounces.	
Nitrogen	28	equivalent to	6	8	Nitrate of Soda.
			11	2	Cotton Seed Meal.
Phosphoric Acid	6	"	2	1	Dissolved Bone Black.
Potash	21	"	3	4	Muriate of Potash.

for each 100 square feet of bench space proved excessive for both crops and positively injured the plants as well as reduced the yield.

20. In the second crop Lorillard was superior to either Acme or Essex Hybrid for forcing.

Crops of 1898–1899.

[Hitherto unpublished.]

Two crops of Lorillard tomatoes were grown: Sutton's "Best of All" was used in one plot in the second crop. Soils of compost and of coal ashes and peat were placed in alternate plots throughout the house. Each combination of soil and fertilizers was made in triplicate sets, the plots being in various parts of the house. Three plots were filled with compost which had been "sterilized" by heating for one hour with steam. Nitrogen was furnished to different plots of coal ashes and peat in form of nitrate of soda, cotton seed meal and fine bone, respectively.

The chief points noted in the results are as follows:

21. There was practically no difference in the average yields from plots dressed with nitrogen in nitrate of soda, cotton seed meal or ground bone. The yield from plots dressed with bone was slightly below the others.

22. The soil of coal ashes and peat on the average yielded more tomatoes than the compost.

23. "Sterilizing" the compost by heating for one hour with steam caused it to produce a heavier growth of plant, and a smaller yield of fruit.

24. A poor subsoil which was used in the benches, whether fertilized with chemicals or not, produced only about one-third as much weight of tomatoes as the compost.

25. Sutton's "Best of All" gave a slightly larger yield than Lorillard as well as fewer and heavier fruits per plant. It was somewhat later in blossoming and maturing fruit. It does not appear to be greatly superior to Lorillard as a forcing variety.

Methods of Pollination. Tomatoes grown under glass will not ordinarily set fruit unless hand-pollinated, because the insects and other agencies that effect pollination in the field are absent from the forcing house. We have usually pollinated the flowers by holding a spoon or ladle under each blossom and tapping the flower from above with a pencil or small stick. The jarring of the flower shakes the pollen into the spoon and brings the stigma in contact with it. We have always found this method satisfactory. A visitor related his success in effecting pollination by pulling away the corolla of the flower after

it had fully opened. In the tomato flower the stamens are united to the corolla and in tearing this off the anthers are broken open and the pollen, if ripe and dry, escapes into the air and some usually reaches the pistil of the flower and fertilizes it.

In growing the second crop of tomatoes described in this paper, this method of pollination was given a trial in a few small plots wholly outside the fertilizer experiment.

Blossoms pollinated in this manner produced as many fruits as where the spoon method was used, nearly every one setting. The spoon method, however, took less time, and it seems more likely to effect cross-fertilization, which, on the whole, is probably to be desired if the grower wishes to improve his strain or variety of plants.

II. OBSERVATIONS ON GROWING LETTUCE UNDER GLASS.

In the 19th Report of this Station for 1895, pp. 93-95, is an account of some experiments in raising lettuce under glass, which showed that:

1. Lettuce of good quality was grown in soil made of coal ashes and peat moss dressed with fertilizer chemicals.

2. The lettuce crop—roots and heads—took from such a soil the following quantities of the elements named, per 1,000 heads:

	Grams.		Pounds.	Ounces.	
Nitrogen	282.6	equivalent to	3	15	Nitrate Soda.
Phosphoric Acid	87.7	"	1	2	Dissolved Bone Black.
Potash	621.0	"	2	10	Muriate.

3. To supply this plant food to the soil, it was necessary to mix with the coal ashes and peat the following quantities of fertilizers per 1,000 plants or per 387 sq. feet:

	Pounds.	Ounces.
Nitrate of Soda	9	13
Dissolved Bone Black	2	15
Muriate of Potash	3	8

Lettuce has been raised in the forcing house every year since 1895, and a brief account of our observations follows:

In nearly all cases only the Boston market varieties were planted.

The seed was sown in flats, and when the plants were large

enough to handle they were pricked out in the benches, 4 inches apart each way. Later the plants were again transplanted and then set 8 inches apart in the trial plots.

In 1896, twenty plots on the center bench of the newly completed forcing house were planted to white tennis ball lettuce, each plot being 5¾ inches deep and having an area of 14.5 square feet.

Ten of these plots were filled with a rich compost of rotted turf and horse manure and ten with coal ashes, sifted through a sieve with 4 meshes to the inch, with which 5 per cent. of peat moss, passed through the same sieve, had been carefully mixed.

During the season 3 crops of lettuce were grown on each of the plots.

1. Sub-irrigation was practiced in two plots of each kind of soil, but the yield of lettuce was smaller than where surface irrigation was employed.

2. With the mixture of coal ash and peat moss, an application of 162.9 grams of nitrate of soda, containing 26 grams of nitrogen per plot, with 49 grams of dissolved bone black—equivalent to 8.1 grams of phosphoric acid—and 88.8 grams of muriate of potash—equivalent to 44 grams of potash—gave as good results as any larger amounts of these ingredients.

3. The yield from plots of coal ashes alone was decidedly less than from the mixture of ashes and peat moss.

4. From the compost soils to which only small quantities of nitrate were added, no larger yields were got than from the corresponding ashes and peat plots, but when to the compost were added the same amounts of fertilizers as to the ashes and peat, the yields were larger from the compost. In all cases more marketable heads were got from the compost plots.

In the experiments of the next season, 1896–1897, a mixture of from 9 to 12 per cent. of peat moss with coal ashes proved to be a better soil medium for lettuce than mixtures containing less than that amount.

For these tests the following quantities of chemicals were mixed with the soil of each plot:

Nitrate of Soda	231	grams,	equivalent Nitrogen	32.5
Dissolved Bone Black	47.7	"	" Phosphoric Acid	7.1
Muriate of Potash	95.5	"	" Potash	44.4

In soil containing twelve per cent. of peat moss 1,000 plants, —roots and heads—removed:

Nitrogen	443 grams,	equivalent to	6⅛ lbs.	of Nitrate of Soda.
Phosphoric Acid	185 "	"	3 "	Dis. Bone Black.
Potash	697 "	"	$3\frac{1}{16}$ "	Muriate of Potash.

In 1897–1898, the black swamp muck of this neighborhood (Beaver Swamp), which contains no fiber, proved quite inferior to peat moss as a soil medium.

A number of comparisons were made of the growth of lettuce on rich compost and of its growth on the same kind of compost which had been "sterilized" by heating it for one hour with live steam, which raises the temperature of the soil to above 100 C.

Rawson's Hot-house and Grand Rapids were the varieties used, 18 plants of each being set in each plot.

In every case a better crop was grown on sterilized soil than on the corresponding plots untreated. Lettuce transplanted only once was much larger and heavier than that which was twice transplanted. Fertilizer chemicals depressed the yield in each case, while the addition of lime did not greatly affect the weight or quality of the crop. The following table shows the results obtained from these cultures:

Number of Plot.	192	193	200	201	202	203	204	205
Compost Soil, how treated	Sterilized.	Sterilized.	Not Sterilized.	Not Sterilized.	Not Sterilized.	Not Sterilized.	Sterilized.	Sterilized.
How fertilized	Fert. Chemicals.	Lime.	Fert. Chemicals.	Lime.	0	0	0	0
Number of transplantings	2	2	2	2	2	1	2	1
Yield grams.								
Hot-house, 18 plants	1206	1224	702	1080	1098	1080	1172	1019
Grand Rapids, 18 plants	1989	2096	1188	1434	1984	2236	2152	2808
Total weight, both varieties, gms.	3195	3320	1890	2514	3082	3316	3324	3827

III. CARNATION CULTURES, SEASON OF 1898-99.

This work is a continuation of the experiments described in the Twenty-first Annual Report of this Station for 1897, page 293, and as the house, benches and plots were there described

and figured on page 309, it is unnecessary to further describe them here, except to state that the carnation cultures occupied the plots 174 to 185 of the house F, which is shown on page 228 of the present report.

In the season of 1897-1898 the yields of carnation blooms were rather small and the differences between the yields of plots differently fertilized were not striking.

Many plants, too, were injured or destroyed by the stem-rot disease, all of which made the tests quite unsatisfactory for the purposes of our experiments.

In the season of 1897-1898 the largest number of blooms per plant was produced on rich compost to which nitrate of soda, dissolved bone black and muriate of potash had been applied at the rate of 620 grams, 154 grams and 422 grams respectively per 100 square feet of bench space, while the compost without fertilizers gave a slightly smaller yield of blooms than the soils made of coal ashes with 3 per cent. of peat to which were added 1240 grams of nitrate of soda, 462 grams of dissolved bone black, and 844 grams of muriate of potash per 100 square feet of bench space.

Experiments of 1898-1899.

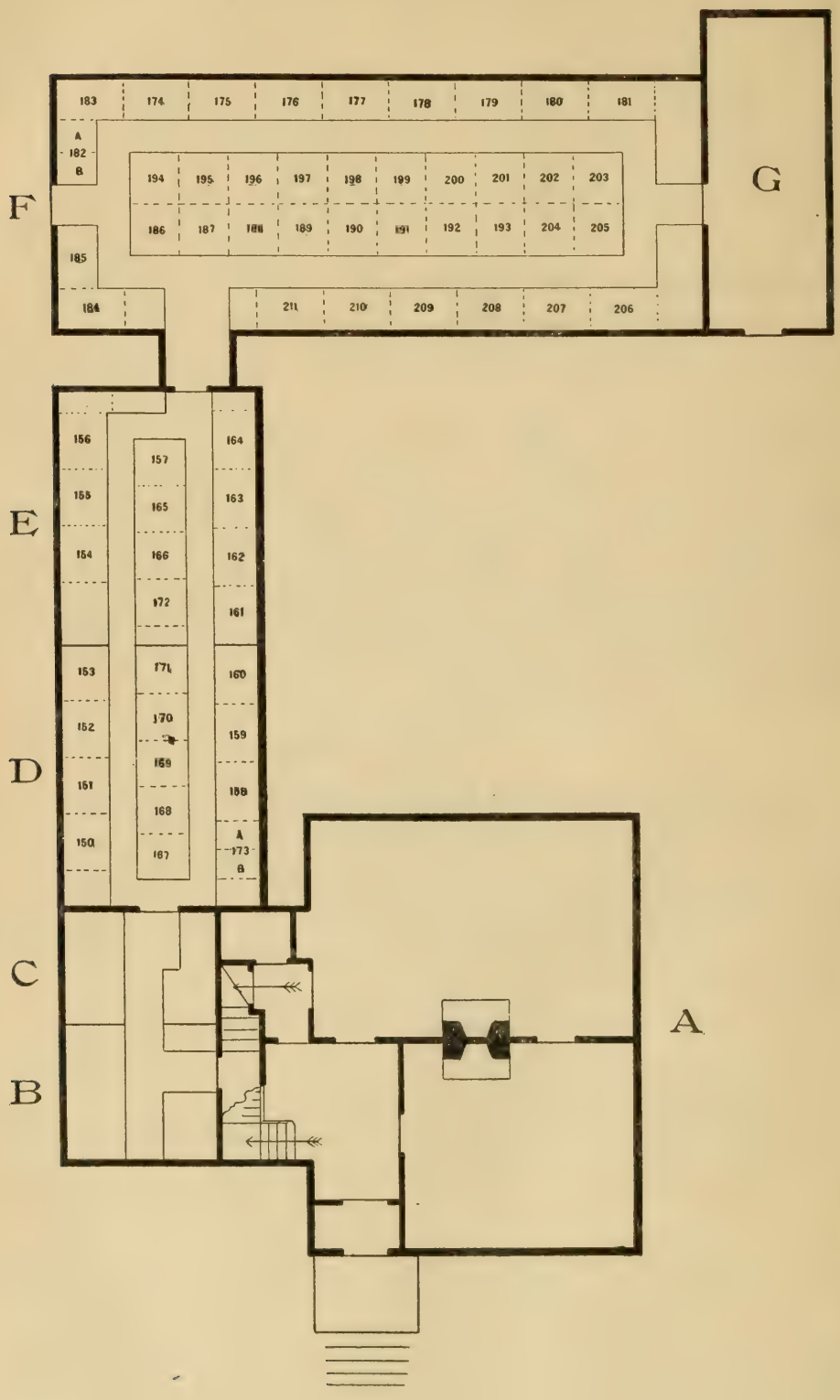
Soils and Fertilizers—Seven of the plots (174 to 180) were filled with a mixture of 184 pounds of bituminous coal ashes and 5½ pounds of peat moss, both sifted by passing a wire screen having four meshes to the inch. Two plots (181 and 182) were filled with sterilized* compost, and three others (183 to 185) with unsterilized compost.

To all the plots which were filled with ashes and peat, as well as to plot 184, filled with compost, were added commercial fertilizers in the quantities given on pages 231 and 232.

The fertilizers used were nitrate of soda with 15.82 per cent. of nitrogen, cotton seed meal with 4.48 per cent., bone dust with

* The sterilization was done by heating for 60 minutes in steam, as described in our report for 1897, page 310. Examination in the laboratory has shown that this method destroys all molds and yeasts, with their spores, and with few—and in many cases with no—exceptions, destroys all forms of bacteria which will grow in presence of oxygen. With this explanation we use the term "sterilized" in this paper to describe soil treated by the method referred to.

Plan of Forcing House.



4.94 per cent. of nitrogen and 19.98 per cent. of phosphoric acid, dissolved bone black with 16.97 per cent. phosphoric acid and muriate of potash with 46.63 per cent. of potash.

In every case the fertilizer was thoroughly mixed with the whole body of soil before it was put into the plot.

The plots were filled on September 15th, 16th and 17th.

Plants—The plants were obtained from a neighboring carnation grower early in May, and were making good growth when received. They were planted in a sandy and not over-fertile soil in a dry situation and made a rather slow growth during the season, though the plants were doing well when transferred to the house, September 19th. Six plants each, of Daybreak, Thomas Cartledge and Lizzie McGowan varieties (making eighteen in all) were set in each plot, with the exception of plot 183, which not being of full size, received three Thomas Cartledge plants and six of each of the other varieties. A few of the supposed Thomas Cartledge plants proved to be Eldorado. The Lizzie McGowan variety was seriously damaged by the stem-rot disease which is mentioned in a note at the end of this paper.

Notes During Growth—The day after setting the plants the soil was moved away from the base of each stem and the stems, after drying off, were coated with Bordeaux Mixture. After the mixture had become dry the soil was replaced; two months later this treatment was repeated, the object sought being to learn if by this means the plants could be kept free from the disease known as stem-rot. A fuller discussion of this disease and treatment appears on page 236.

On October 18th the plants were beginning to grow and buds were appearing on the Daybreaks. The Cartledge plants suffered from "rust" and "spot," which was soon checked by picking off all diseased leaves and spraying occasionally with potassium sulphide solution, one ounce of the sulphide in two gallons of water, to which a little fir-tree-oil had been added. The Lizzie McGowan variety was least subject to disease at first, but did not grow as fast as the others and later in the season was seriously injured and many plants killed by stem-rot. On December 9th Daybreaks were beginning to blossom freely. On March 10th red spider became troublesome in the south end of the house, and a spray of water was applied as a

remedy. This doubtless aggravated the stem-rot disease. All lateral buds were removed as they appeared, leaving only the terminal buds to open.

Toward the end of the season the blossoms were smaller and all the plants were light-colored and apparently in need of more plant-food.

The temperature of the house was kept between 60° and 65° F. during the day, and about ten degrees lower at night.

On June 29th the plants were removed from the benches.

At all times during their growth those which grew in the mixtures of coal ashes and peat appeared to be quite as thrifty as those growing in the compost.

Harvesting—The blossoms were picked twice each week in about the same way as if for market, but the diameter and length of stem of each blossom was recorded, as well as the total weight of each variety from each plot. From the fresh weights of the crops and the chemical analyses of the cut flowers were computed the quantities of nitrogen, phosphoric acid and potash, which had been removed from the soil by the flowers.

The following tables are a statement of the yields from the several plots and also show the fertilizers employed:

TABLE I.—CARNATION CULTURES 1898–1899. SOIL OF COAL ASHES AND PEAT MOSS.

Number of Culture Plot	174			175			176			177			178			179			180		
Fertilizers Applied.																					
Nitrate of Soda, grams	190.			285.			----			----			----			----			95.		
Cotton Seed Meal, "	----			----			1012.5			1350			----			----			337.5		
Ground Bone, "	----			----			----			----			910.8			1214.4			303.5		
Equivalent Nitrogen, "	30.			45.			45.			60.			45.			60.			45.		
Dissolv'd Bone Black, gr'ms	70.68			70.68			70.68			70.68			----			----			70.68		
Equivalent Phos. Acid, "	12.			12.			12.			12.			----			----			12.		
Muriate of Potash, "	129.			129.			129.			129.			129.			129.			129.		
Equivalent Potash, "	60.			60.			60.			60.			60.			60.			60.		
Yield.																					
Number of blooms per plot	225			241			263			267			274			240			236		
Weight of blooms per plot, grams	1986			2066			1876			1999			2191			2014			1758		
Variety	Thomas Cartledge.	Lizzie McGowan.	Daybreak.	Thomas Cartledge.	Lizzie McGowan.	Daybreak.	Thomas Cartledge.	Lizzie McGowan.	Daybreak.	Thomas Cartledge.	Lizzie McGowan.	Daybreak.	Thomas Cartledge.	Lizzie McGowan.	Daybreak.	*Thomas Cartledge.	Lizzie McGowan.	Daybreak.	*Thomas Cartledge.	Lizzie McGowan.	Daybreak.
Number of blooms	108	14	103	80	57	104	122	39	102	113	61	93	127	43	104	83	67	90	66	56	114
Weight of blooms, grams	909	90	987	768	382	916	831	278	767	836	417	746	1027	280	884	744	508	762	514	385	859
Ave. weight of blooms, "	8.4	6.4	9.48	9.6	6.7	8.8	6.8	7.1	7.5	7.4	6.8	8.02	8.08	6.5	8.5	8.9	7.5	8.4	7.8	6.7	7.5
Ave. diameter of blooms, inches	2.07	2.16	2.29	2.33	2.20	2.25	2.05	2.25	2.13	2.02	2.33	2.11	2.07	2.21	2.11	2.10	2.32	2.13	2.06	2.30	2.09
Ave. length of stem, inches	12.9	9.8	14.4	14.08	11.6	14.2	10.9	11.5	12.4	12.	11.4	12.4	12.8	11.1	13.2	13.	12.4	13.1	13.4	12.6	11.8
Ave. No. of blooms per plant	18	2.3	17.1	13.1	9.5	17.3	20.3	6.5	17	18.8	10.1	15.5	21.1	7.1	17.3	13.5	11.1	15.	11	9.3	19

* Partly "Eldorado" variety.

TABLE II.—CARNATION CULTURES 1898–1899. COMPOST.

Soil	Not Sterilized.			Not Sterilized.			Sterilized.			Sterilized.			Sterilized.		
Number of Culture Plot	181			182			183			184			185		
Fertilizers Applied.															
Nitrate of Soda, grams	----			----			----			95.			----		
Equivalent Nitrogen, "	----			----			----			15.			----		
Dissolved Bone Black, "	----			----			----			23.56			----		
Equivalent Phos. Acid, "	----			----			----			4.			----		
Muriate of Potash, "	----			----			----			64.5			----		
Equivalent Potash, "	----			----			----			30.			----		
Yield.															
Number of blooms per plot	210			232			290			118			141		
Weight of blooms per plot, grams	1731			1611			1818			728			977		
Variety	*Thomas Cartledge.	Lizzie McGowan.	Daybreak.	*Thomas Cartledge.	Lizzie McGowan.	Daybreak.	†Thomas Cartledge.	Lizzie McGowan.	Daybreak.	Eldorado.	Lizzie McGowan.	Daybreak.	Eldorado.	Lizzie McGowan.	Daybreak.
Number of blooms	47	60	103	99	58	75	132	48	110	42	33	43	40	36	65
Weight of blooms, grams	510	436	785	704	391	516	1126	322	933	303	192	233	330	231	416
Ave. weight of blooms, "	10.8	7.2	7.6	6.1	6.7	6.8	8.5	6.7	8.4	7.2	5.8	5.4	8.2	6.4	6.4
Ave. diameter of blooms, inches	2.30	2.22	2.06	2.05	2.10	1.99	2.05	2.08	2.30	2.10	2.01	1.91	2.13	2.18	1.95
Ave. length of stem, "	15.1	12.7	11.7	11.2	11.1	12.4	11.7	11.4	13.1	13.7	9.9	9.9	14.2	11.4	12.
Ave. No. of blooms per plant	7.8	10.	17.1	16.5	9.6	12.5	22	8	18.3	7	5.5	7.1	6.6	6	10.8

* Partly Eldorado variety.

† Only three plants: calculated in table as full plot.

TABLE III.—AVERAGE YIELDS FROM DIFFERENT FORMS OF NITROGEN.

	Coal Ashes and Peat Moss.				Compost.	
	Nitrate Nitrogen.	Cotton Seed Meal Nitrogen.	Bone Nitrogen.	Nitrogen from three sources.	Not Sterilized.	Sterilized.
Average yield per plot of three varieties.						
Number of blooms	233	265	257	236	221	290*
Weight of blooms, grams	2026	1937	2102	1758	1671	2382
Ave. weight of blooms, "	8.7	7.3	8.1	7.4	7.5	8.2
Diameter of bloom, inches	2.25	2.15	2.15	2.15	2.12	2.21
Length of stem, "	12.8	11.7	12.6	12.6	12.3	12.0
Excluding McGowan variety.						
Number of blooms	197	215	202	180	162	242
Weight of blooms, grams	1790	1590	1708	1373	1257	2059
Ave. weight of blooms, "	9.0	7.3	8.4	7.6	7.7	8.5
Diameter of blooms, inches	2.23	2.07	2.10	2.07	2.10	2.17
Length of stem, "	13.9	11.9	13.0	12.1	12.6	12.4

Summary.

1. The four plots, 174, 175, 176 and 177, which contained the mixture of coal ashes, peat and commercial fertilizers, yielded a larger number of blooms, a greater weight of blooms and blooms of somewhat larger size, *on the average,* than the two plots 181 and 182, which contained rich unsterilized compost.

2. Plot 183, of "sterilized" compost, yielded more blooms than any other in the experiment, though the average weight of blooms was not as great as of those grown in the coal ashes and peat moss. The other plot of "sterilized" soil, No. 185, gave a very small yield. We believe that this is explained by the fact that through an oversight of the attendant it was omitted in the watering on a bright day and the plants were badly wilted.

The plot with sterilized soil to which artificial fertilizers were added yielded less than any other.

3. The comparison of the different forms of nitrogenous fertilizer, plots 174 to 180, indicates that fairly good results may be obtained with either nitrate of soda, cotton seed meal or bone.

* Yield of a single plot, No. 183.

Plot 178, to which bone was added, yielded a larger number of blooms than any other. The blooms, on the average, were not larger than those from plots where nitrate or cotton seed meal was used.

The nitrate plots produced blossoms having a greater average weight, diameter and length of stem than those from plots where other forms of nitrogen were used.

Blooms of average size and quality from plots 175, 177, 179, were analyzed. Also a sample was taken from plots 181, 182 and 183 to represent the compost soil. Ten blossoms of each variety, making thirty in all, composed each sample. The samples from the coal ashes plots were drawn from the plots having the larger quantity of nitrogen from each of the three different sources.

Assuming the composition of the blooms grown in soil with less nitrogen to be the same as that of the samples, the average yields (weight) of flowers from each source of nitrogen removed from the soil the following quantities of nitrogen, phosphoric acid and potash:

Source of Nitrogen.	Removed in blooms.		
	Nitrogen.	Phosphoric Acid.	Potash.
37.5 gms. in Nitrate of Soda	8.71 gms.	3.48 gms.	15.03 gms.
52.5 " Cotton Seed Meal	9.33 "	6.37 "	9.52 "
52.5 " Bone	9.61 "	12.15 "	14.70 "
Compost unsterilized	7.93 "	8.25 "	15.26 "
" sterilized	11.26 "	11.75 "	21.73 "

Ten thousand blooms of Daybreak, Cartledge and Lizzie McGowan varieties in equal numbers, grown in soil of coal ashes and peat, fertilized with nitrate of soda, dissolved bone black and muriate of potash, weigh 214 pounds and contain 373.81 grams of nitrogen, 149.35 grams of phosphoric acid, and 645.06 grams of potash. These quantities are equivalent to 5 pounds 2 ounces of nitrate of soda, 1 pound 15 ounces of dissolved bone black, and 3 pounds 1 ounce of muriate of potash.

The same number of blooms grown in compost soil weigh 178 pounds and contain 388.27 grams of nitrogen, 405.17 grams of phosphoric acid and 756.20 grams of potash equivalent to 5 pounds 5 ounces of nitrate of soda, 5 pounds 5 ounces of dissolved bone black and 3 pounds 7 ounces of muriate of potash.

It is interesting to note that the flowers gathered from the plots filled with the mixture of coal ashes and peat moss and fertilized with cotton seed meal as well as those fertilized with ground bone actually removed more nitrogen from the soil than those from the nitrate plots, while the greatest quantity was taken up in the blossoms from the sterilized compost.

Blooms from bone-fertilized plots contained a larger percentage of phosphoric acid, while the smallest percentage of this substance was found in flowers from the nitrate plots. The greatest quantity of potash was removed in the blooms from the sterilized compost and the smallest from the coal ashes plots fertilized with cotton seed meal.

THE STEM-ROT DISEASE.

By W. E. Britton.

In our experiments of 1896-1897, Report of this Station for 1897, page 293, the William Scott variety of carnation was attacked by a disease known among growers as "Stem-rot" and "Die-back." Dr. Sturgis* found it to be caused by a fungus of the genus *Fusarium,* which develops in the stem of the plant at or just below the surface of the ground and so fills the ducts of the stem with its vegetative and fruiting threads as to wilt the plant and finally kill it by cutting off the water supply of the stem and leaves. The fungus occasionally fruits on the stems of the dead plants, appearing there as a pinkish mold. Other investigators have recorded similar diseases of cotton, tomatoes, melons and watermelons, caused by species of *Fusarium.* During 1897 the writer found snap dragon (*Antirrhinum*) plants affected with a similar disease. These plants were growing in the field near carnations, and about half of them wilted gradually and finally died. In a few cases the characteristic pink mold was found on the stems and under the microscope the spores appeared to be identical with those from the carnations. In the fall of 1898, asters sent to the Station showed what seemed to be the same disease. The stems, placed in a moist chamber, were soon covered with spore masses of a salmon pink color. It seemed probable that the carnation, snapdragon, and aster plants were attacked in a similar manner by the same or by closely related organisms. This was pointed out by the writer in an article published in *The American Florist* for November, 1898, and afterward reprinted in *Gardening,* Vol. VII, No. 153, page 138.

Just how the plants become infected has not been definitely determined, but probably the spores live over winter in the soil and gain access to the plant through the roots or stem beneath the surface of the ground. Attempts to inoculate healthy plants above ground failed, while seemingly healthy plants one after another became diseased in the field as well as after being set in the forcing-house benches.

* Report of this Station for 1897, page 175.

In 1896–1897, and in 1897–1898 the William Scott variety was so badly diseased with stem-rot that it was afterward discarded in our cultures. The Lizzie McGowan proved to be the next most susceptible variety.

In the cultures described in a previous paper, the plants were set in the house on September 19th. On the following day the soil was removed around each plant to the depth of about two inches, and after the stems had become dry on the surface they were painted over with Bordeaux Mixture prepared from five pounds sulphate of copper, five pounds of lime and fifty gallons of water. When the fungicide had become dry upon the stems the soil was replaced.

On November 12th one plant of plot 184 had died from stem-rot and was replaced.

About two months after the plants were set in the benches the Bordeaux Mixture treatment was again applied.

On December 9th a dead plant in plot 176 was removed and replaced. On the 20th a diseased plant was taken from each of plots 174 and 185, and apparently healthy plants were set in their places. During January and February several plants died from stem-rot, but all were of the Lizzie McGowan variety. During the first part of the season and as long as the supply lasted healthy plants were set in place of the diseased ones, but these soon became diseased and died. At the time the plants were removed from the benches on June 29th, the stem-rot had killed:

11	plants	in	plot 174	Soil consisting of Coal Ashes and Peat. Average number of diseased plants per plot 4.3.
2	"	"	175	
7	"	"	176	
1	"	"	177	
4	"	"	178	
1	"	"	179	
4	"	"	180	
3	"	"	181	Soil consisting of Compost. Average number of diseased plants per plot 3.4.
0	"	"	182	
3	"	"	183	
3	"	"	184	
8	"	"	185	

One diseased plant in plot 180 and one in plot 184 were of the Thomas Cartledge variety. All others were Lizzie Mc-

Gowans. It must be remembered that only six plants of this variety were set in each plot at the beginning of the experiment, and that more would doubtless have died had the practice of resetting been continued to the end.

The loss from diseased plants was slightly greater in the soil of coal ashes than from compost.

The fact that seemingly healthy plants one after another became diseased and died after setting in the benches where diseased plants formerly stood, not one of them escaping attack, is a strong indication that infection takes place beneath the surface of the soil either through the stems or roots. Coating the stems with an active fungicide did not save the plants, as it would probably have done if the fungus entered the stem of the plant near the surface of the ground. Whenever the upper portion of the plant exhibited symptoms of the stem-rot an examination showed that the root-system was badly diseased or nearly dead. Removing a diseased branch has never saved a single plant so far as the writer's observation extends. These facts lead him to suspect that the fungus gains access to the tissues of the plant either through the rootlets or through some portion of the root-system considerably below the surface of the soil, and that when the top begins to wilt, the plant is already in the last stages of the disease.

NOTE REGARDING THE EFFECT OF THE WINTER UPON CHESTNUT GRAFTS AND CIONS.

By W. E. Britton.

Some experiments in chestnut grafting were described in the Twenty-second Annual Report of this Station for 1898, page 276. In the conclusions therein presented it was stated that "from a single season's experience (1898) it would appear that the best time for grafting chestnuts in this vicinity is from May 15th to June 15th." The work was continued during the season of 1899, and as the winter of 1898-1899 was an exceptionally severe one, injurying many plants and trees that are usually considered hardy in this latitude, it is well to note the effect of the season upon the chestnut grafts. Nearly all the 1898 grafts were cut back severely in the spring of 1899 for the purpose of obtaining cions. Upon examining the grafts set in 1898 during the summer of 1899, it was found that the early set cions, that made the largest growth, withstood the effects of the winter better than those set late in the season. Cions set later than June 15th were all dead, and in some cases the stocks had been killed back to the ground. One cion set May 6th, which made a growth of over six feet in 1898, lived through the winter and made a total growth of over twenty-one feet in 1899. Others set the same day and which grew well in 1898, also made a good growth in 1899 and were then killed presumably by the extreme drought which prevailed through the latter part of the season. So that with the combined effect of winter and drought, the percentages of cions set in 1898 and now alive is very small.

About one hundred cions were set in 1899. These were cut for the most part from grafts of the previous season, and though they appeared to be in good condition at the time of cutting, many of them had suffered injury and after storing for a few weeks in the usual manner turned black under the bark and were unfit for use. Some of the cions which had been set early turned black in a similar manner, and under these conditions it would have been a waste of time and money to carry on extensive grafting experiments. A few lived, however, and made good growth during the season. Others started and were killed by drought, so that very few are now alive.

INSECT NOTES.

By W. E. Britton.

The season of 1899 being remarkable for the cool weather and the small rainfall during the summer months, was especially favorable for the development of insect life. A large proportion of the insects sent to the Station for identification were scales. This may be an effect of the agitation and discussion over the San José Scale and indicates that fruit growers themselves are now looking for scale-insects in their orchards and nurseries.

The following notes are suggested by observation and correspondence:

A New Enemy of Peas—During the first week of July, both garden and sweet peas growing at the Station were seriously injured by a species of plant-louse. Soon after, specimens were received from Plantsville, Wolcott and several places about New Haven. Growers had never been troubled by similar pests before. Much injury to the pea crop was also reported in the canning districts of Delaware and Maryland. The pest was also found in Virginia, North Carolina, Pennsylvania, New Jersey, New York, Vermont, Ohio and Canada. A remarkable feature of this attack is that it was caused by a new and undescribed species previously unknown to entomologists as well as to pea-growers; and the fact that it appeared so suddenly and in such abundance as to seriously threaten an entire crop in a single season, is another proof of what has often been noticed, viz.: that when an insect is brought into a new country or changes its food plant it frequently becomes vastly more injurious than it ever was before.

Prof. W. G. Johnson, Entomologist of the Maryland Agricultural Experiment Station, has described this louse* and given it the name *Nectarophora destructor*. In a paper before the Eleventh Annual Meeting of the Association of Economic Entomologists, at Columbus, Ohio, August 18th and 19th, 1899, Prof. Johnson reports that the losses to the pea crop in the State of Maryland, caused principally by this insect, have been estimated by conservative authorities at $3,000,000, for the season.

*Canadian Entomologist, February, 1900, page 56.

Some of the Maryland growers report that the pest was present in their fields during 1898 and Prof. J. B. Smith stated that it was found upon late peas on the Experiment Station grounds at New Brunswick, N. J., in that year.

When badly infested plants in the Station garden were sprayed with whale-oil soap, one pound in five gallons of water, almost every insect was killed. In small gardens this treatment can be applied with ease and will insure a crop for table use; but in canning districts where peas are grown in areas of several hundred acres, the problem of destroying the pest is harder to solve, for to spray the vines might cost more than the crop would be worth. Kerosene and water (fifteen per cent. of kerosene) gave good results in the trials at the Maryland Station.

Prof. Johnson thinks that the species formerly subsisted upon one of our wild plants and reports several natural enemies of the "Destructive Green-Pea Louse," including syrphus flies, lady beetles and lace-winged flies. Some of these attacked the lice late in the season of 1899, but too late to be of any benefit to the grower. If these beneficial insects should increase with sufficient rapidity and not in turn be held in check by their natural enemies, the "Destructive Green-Pea Louse" would be largely destroyed without resorting to spraying. It is advisable, however, for every one who raises either sweet peas or garden peas next summer to be prepared to fight this pest in the manner suggested above.

Woolly Aphis on Elm Trees—During the latter part of June branches of an elm tree were sent to the Station which were infested with the Elm Tree Woolly Aphis *Schizoneura Rileyi* Thomas, described by Riley as *Eriosoma ulmi* in the first annual Report of the State Entomologist of Missouri for 1868. Dr. Riley stated that several trees in the city of Chicago had to his knowledge been killed by this insect.

The lice congregate in clusters on the branches or trunk of the tree and cause irregular warty growths and are usually found in dead sunken areas formed by their depredations. The insects are bluish white and are covered with a white substance resembling cotton or wool. The species is similar to the Woolly Aphis of the apple, *S. lanigera* Hausm, and may be destroyed in the same way by applying to the bodies of the insect a mixture

of whale-oil soap and water, or kerosene and water. Unless the insecticide come in direct contact with the lice it will not prove effectual.

Spruce Bud Louse—On June 8th some spruce twigs sent for examination to the Station were found to be infested with the Spruce Bud Louse *Adelges abieticolens* Thomas. This insect is a broad, flat, plant-louse with slender, short, five-jointed antennæ, and without honey tubes. It attacks the spruce, deforming the terminal shoots and sometimes producing large swellings that are mistaken for cones. The European species, *A. abietis* L., also attacks the Norway Spruce in Massachusetts and produces a similar injury.

A spray of fir-tree oil, one-half pint in two gallons of water, will doubtless kill the Spruce Bud Louse.

Scale Insects—In the Report of this Station for 1898, page 273, it was mentioned that a new scale, *Lecanium,* on grape had been found in Connecticut. It was sent to the Station again this year from the same locality, and Mr. Pergande of the Division of Entomology, U. S. Department of Agriculture, has pronounced it *Lecanium armeniacum* Craw, a species common and abundant on the Pacific coast. Besides the grape it attacks all our common fruit trees and has now spread into the Eastern States as an addition to our already long list of fruit pests.

Several new localities infested with San José Scale have been brought to light during the year. One of the most important things to note, however, is the bringing into the State of two other species closely resembling the San José Scale, and probably just as undesirable. Both were shipped into Connecticut upon nursery stock and according to the statement of the purchasers each came under a certificate of inspection. One of these, *Aspidiotus forbesi* John. was found in 1894 and described in 1896 by Prof. W. G. Johnson, now of the Maryland Experiment Station. Prof. Johnson* found it infesting cherry trees in Illinois and considered it the most dangerous scale insect then established in the State. He states that the insect is found on wild and cultivated cherry, apple, plum, pear, quince and currant. It was shipped into Connecticut on apple trees from Pennsylvania.

* Bulletin Illinois State Laboratory of Natural History, Vol. IV, p. 380.

The other species is *Aspidiotus ostræformis* Curtis, a form of European origin and introduction, lately discovered in this country, which bids fair to become a very serious enemy to fruit trees. It greatly resembles the San José Scale and has been mistaken for that species many times. It has become well established in central New York and has been reported in Michigan and in Canada. It was shipped into Connecticut on pear trees from New York.

Either of the above mentioned scale-insects are from all accounts liable to become quite as troublesome to Connecticut fruit growers as the San José Scale. Hence the necessity of orchardists and nursery men giving their orchard trees and nursery stock the most rigid inspection not only once, but several times each season. Any new or suspicious scale-insects should be sent to the Station, where judgment can be passed upon them and treatment advised.

Beetle Infesting Wheat Middlings—A sample of wheat middlings taken from a dealer for chemical analyses and stored for some time in the chemical laboratory was found to be filled with small brown beetles. It was at first supposed to be the "saw-toothed grain weevil," *Silvanus surinamensis* L., which is common here, but as the sides of the thorax were found to be smooth instead of serrate, specimens were submitted to the Division of Entomology, U. S. Department of Agriculture, Washington, D. C., where they were identified as *Læmophlæus pusillus* Sch. Mr. Chittenden, who has made a special study of the insects infesting stored grains, thinks that this beetle is usually a scavenger not capable of doing much injury, but its economic position has not yet been definitely determined. The species is a common and widely distributed one, closely related to the "saw-toothed grain weevil." The same remedy will therefore suffice for both species and consists in enclosing the grain in a tight box with a shallow dish of carbon bisulphide inside. This substance is volatile and the fumes permeate the grain and kill all animal life therein. One pound of the liquid is sufficient for one hundred bushels of grain. As carbon bisulphide is very inflammable, care should be taken to keep all forms of fire away from it.

Flea-Beetle Injuring Primroses—Nearly all the plants of the Evening Primrose *Œnothera biennis* L. growing about New

Haven were defoliated early in the summer by a small dark-blue flea-bettle. Both adults and larvæ devoured the foliage. Later in the season the same insect attacked the cultivated primrose in gardens, which is probably a variety of *Œ. fruticosa* L. Plants of this species growing in Edgewood Park were rendered unsightly by losing all foliage from the attacks of the insect, nothing but the bare stems remaining. As the plant is a vigorous perennial and the tops die in the fall, it was probably not vitally injured, but made unsightly, which defeats its use as an ornamental plant. Applying insecticides to foliage will of course prevent destruction by this leaf-eating insect. Adult beetles were sent to the Academy of Natural Sciences, Philadelphia, Pa., and identified by Dr. Henry Skinner as *Haltica marevagans* Horn. Injury to primroses by this insect has never before been observed by the writer.

Decrease of Fall Canker-Worms—During the season the Fall Canker-worm, *Anisopteryx pometaria* Harr., was much less abundant upon the Station grounds than for several years. The number of adults to emerge in the fall and early winter was not noticeably less than usual, but the larvæ were certainly much fewer and did less damage than in previous seasons. Here at the Station this species is responsible for all the canker-worm injury, while in certain localities half a mile distant the spring canker worm, *Paleacrita vernata* Peck., is the only species that can be found. In some localities both are found together. Canker-worms attack not only the apple and elm trees, but also the plum and cherry as well as the chestnut, hickory and several other forest trees. An experiment is in progress at the Station to determine the effectiveness of bands coated with various substances in combating the adults and larvæ of the Fall Canker-worm. A report of these observations will be made later.

INSPECTION AND CARE OF NURSERY STOCK.*

By W. E. Britton.

Legislation—In fifteen states, laws have been enacted providing for the inspection of nursery stock and in some cases of orchard trees as well. The object of this inspection is to find out whether or not certain noxious insects or fungi are present which threaten the fruit-growing interests of the whole State and to prevent their spread by the sale of infected nursery stock. In many states the law forbids the transportation or sale of any stock which does not bear a certificate from a competent person stating that inspection was made on a given date and that no indications of the presence of noxious insects or fungi were found.

This provision makes it necessary for Connecticut nurserymen to have their stock inspected annually and to get a certificate of inspection in the approved form, as otherwise their stock will be excluded from those states which have inspection laws.

The fact that the inspection laws of different states vary considerably in their requirements is a further annoyance to nurseries which ship stock into all these states. At present Connecticut has no law and as a consequence infested stock may be shipped into this State from any neighboring state where the sale of such stock would be illegal.

Even the inspection and certificate system is inadequate, as has been shown by the fact, noted in a previous paper, that nursery stock has been shipped into this State under cover of a certificate which careful examination showed to be badly infested.

The San José scale has been the exciting cause of most of the inspection laws, a pest which can be extirpated by prompt treatment and which if permitted to live will surely destroy not only our fruit orchards, but also many ornamental trees and shrubs.

This scale has been distributed chiefly by means of nursery stock.

The Scale in Connecticut—The San José scale has been found in over twenty towns of this State, some of them containing

* Reprinted in revised form from Bulletin 129, issued in May, 1899.

several distinct infested localities and mostly situated along the coast. The central portion of the State as far north as Hartford has also been invaded, and probably there are other infested areas not yet brought to our knowledge.

Nursery Inspection in Connecticut—Since the laws of neighboring states debar Connecticut nurserymen from shipping nursery stock into such states unless accompanied by a certificate of inspection, this Station has deputed a member of its staff to inspect nurseries upon application of the owners and to give certificates, in case no scale or other pests of a serious nature are found. Early in 1899 regulations were formally adopted by the State Board of Control regarding such inspection and the granting of certificates. The following circular embodies these rules.

THE CONNECTICUT AGRICULTURAL EXPERIMENT STATION.
NEW HAVEN, CONN.

NOTICE TO CONNECTICUT NURSERYMEN.

Some states, to which Connecticut nurserymen frequently ship nursery stock, have laws designed to prevent the further dissemination of certain insect and fungous pests, by requiring that all stock brought into these states, shall come from inspected nurseries in which none of these diseases have been found, and that a copy of the inspection certificate shall accompany each shipment.

In answer to requests from nurserymen, this Station has made inspections, and has given certificates when the stock was not found infested or diseased.

The following information is given for the benefit of those who may hereafter apply:

1. One of the Station staff, competent to do the work, will inspect any nursery in the State upon the written application of the owner; there will be no charge for the services of the inspector, but his traveling and incidental expenses are to be paid by the nurseryman.

2. If no indications of San José Scale or other serious insect pest, or of dangerous infectious diseases are found, a certificate to that effect will be given.

The finding of any one of these pests or diseases will be a

cause for withholding a certificate until such pests or diseases have been eradicated and the inspector is satisfied that they no longer exist.

3. The certificate will be in the following form:

"This is to Certify, That on..... 19....the undersigned inspected the stock in the nursery of ..... of ..... Conn., and found no evidence of the presence of San José Scale, or other dangerously injurious insect or fungous pest, liable to be introduced into orchards, upon nursery stock."

This form of certificate may be modified by the Station if considered desirable.

4. Upon evidence of the fraudulent use or abuse of certificates by any nurseryman, the Station may refuse to make inspections for him in the future.

5. When stock is known to be infested, nurserymen must take vigorous measures to eradicate the trouble from it. The Station will give advice as to the best methods of procedure. Where such measures are promptly taken by the owner of the nursery, the Station will not ordinarily make known the names of nursery firms having infested stock. The Station, however, reserves the right to publish this information, and will do so when the safety and welfare of the public seem to demand it.

Nursery Practices—As nurserymen and tree dealers generally buy more or less of their stock from various localities, it is not improbable that most of them at some time have thus brought the scale into their nurseries. Whether the insect has remained there and developed or not has depended largely upon their business methods. We wish to call attention to the fact that certain practices are favorable to the development and increase of the scale; and that if such practices are abandoned an infested nursery may more readily become clear of this pest. First of all the nurseryman should make himself familiar with the appearance and habits of the scale insect and should carefully watch his stock. Although much has been published about the insect, there are yet nurserymen who have never seen it and apparently have taken no trouble to inform themselves regarding it.

Experience shows that in a scale-infested nursery the insects are found most commonly and abundantly upon left-over stock which has been planted out and allowed to remain in nursery rows sometimes for three or four years. If any of this stock was even slightly infested when it was first received into the nursery, the insects have had time to multiply and become so numerous that they are easily detected by the inspector. Such stock is rarely of much value, and the nurseryman would do better to destroy it rather than let it remain as a breeding place for pests of all kinds. All unsaleable stock should be promptly destroyed by fire and the remainder fumigated or otherwise treated before planting out.

The official inspector, in examining nursery stock, will properly look over with the greatest care those trees which most commonly are found infested, viz: apple, pear, plum and quince. The San José Scale will attack many other kinds of trees and shrubs.

Scales are not as likely to be disseminated on blackberry and raspberry stock as upon fruit trees because their tops are cut off and burned previous to shipping the plants. Peach stock is also less liable to become infested in the nursery on account of its rapid growth.

The proprietor or foreman who works continually amongst the trees, if he will take the trouble to acquaint himself with the scale, should be the best inspector. He has opportunity to examine the stock when it is received, when it is planted out, during all its growth, and finally when it is dug and prepared for shipment. The official inspector, in making his tour of the nursery, may overlook insects or fungi that would not fail to be detected if he had frequent occasion to traverse the ground.

Suggestions to Orchardists—It is quite as important for the orchardist as for the nurseryman to treat his trees before planting out. The nurseryman should not be wholly blamed for the increase and spread of the scale. Many trees are planted each year only to be neglected, and if such trees are infested, all trees in the immediate vicinity soon become so. Trees can be treated much more effectively and economically before they are planted than afterwards. If it is not feasible for the fruit grower to fumigate them, they can easily be dipped, while bunched, into a solution of whale-oil soap. The tops should first be well pruned

and if the soap solution is in a barrel or deep tank, a bunch of trees can be plunged into it, top first, as far as the roots. It is perhaps best not to dip the roots. This method has been practiced by at least one Connecticut fruit-grower. The expense of such treatment is very slight.

Value of Certificates—The certificate states that an examination has been made and that certain insects and diseases have not been found. It does not, however, guarantee or imply that they are altogether absent. These pests are so difficult to detect, when present in small numbers on a few trees, that no person can so thoroughly examine a nursery of ordinary size in any reasonable time as to be warranted in stating that it is absolutely free from them. If they are but moderately abundant in any portion of the nursery the inspector will readily find them. The value of a certificate, then, is to show that a careful inspection has been made by a competent person, and that the inspected nursery is reasonably free from dangerous diseases and pests.

Treatment.

There are three methods by which the San José Scale may be destroyed with little trouble or expense, viz: (1) Fumigating with hydrocyanic acid gas. (2) Spraying with kerosene and water. (3) Spraying with or dipping the trees in a solution of whale-oil soap.

For nursery stock, fumigation is probably the most efficient and cheapest treatment. It is attended, however, by more or less danger to the operator and should never be entrusted to careless employes. For orchard trees of considerable size one of the other methods will usually be preferred.

Fumigation—A tight box or house is necessary in which to enclose the stock. If the nursery is an extensive one it would probably pay to erect a house of two rooms for the purpose. The walls, roof and floor of such a house should be double boarded with heavy building paper between to make it gas-tight. A suitable number of doors should be arranged for convenience in filling and taking the trees from the house. Roof ventilators which can be opened and shut from the outside are a convenience. A house of this kind is inexpensive, and may be used as a storehouse when not needed for fumigating purposes.

For a small nursery, however, a tight box large enough to take in fruit trees may be used to good advantage.

Prof. W. G. Johnson, of Maryland, who has had much experience in fumigating nursery and orchard trees, recommends* quantities of chemicals as follows for each 100 cubic feet of enclosed space:

25 grams (a little less than 1 oz.) (by weight) Potassium Cyanide 98–99 per cent. pure.

1¼ ozs. (liquid measure) Sulphuric Acid best grade commercial (sp. gr. 1.83).

1⅞ ozs. (liquid measure) water.

The enclosed space should be computed, and the chemicals meted out accordingly. A stoneware jar of suitable size may be used as a generator. The water should always first be put in this and the acid poured in slowly in a thin stream with constant stirring. After filling the house or box with trees, place the jar inside and within easy reach of the door or lid. The cyanide is dropped into the jar and the operator should leave *at once,* and close the house immediately from the outside. *To breathe the fumes may be immediately fatal.* After the trees have been fumigated for half an hour the box or house may be opened *from the outside,* using the greatest care to withdraw at once to a safe distance. Ten minutes should elapse before anyone attempts to remove the trees. The trees, if dormant, will not be injured if left in the gas a much longer time or over night. This treatment is said to kill every form of animal life, and the operators should *use every precaution in handling the chemicals and generating the gas in order to prevent accidents.*

Cyanide of potassium is a most deadly poison.

Kerosene and Water—Kerosene alone has been used as a spray on plants with varying results. It is liable to injure the plants and is not to be advised for that reason. But kerosene can be mixed with water under pressure, a special pump being required for the purpose. Such a pump made by the Deming Co., Salem, Ohio, was figured in Bulletin 126 of this Station, page 7. A similar pump is also manufactured by the Goulds Mfg. Co. of Seneca Falls, N. Y. Two seasons' experience in fighting San José Scale in New York,† shows that 1 part of

* Maryland Agr. Exp. Station Bulletin, 57, p. 93, 1898.

† Cornell Univ. Agr. Exp. Station Bulletin, 155, 1898.

kerosene to 4 parts water (a 20 per cent. mixture) will kill the scale and not injure the plants.

Whale-oil Soap—If one does not care to fumigate or go to the expense of buying a special pump for kerosene and water, he can destroy nearly all the scales by dipping or spraying the dormant trees with the following solution:

Whale-oil soap	2 lbs.
Water	1 gallon.

If the trees are in foliage, one pound of soap in five gallons of water may be used, but this will probably kill only the very young scales.

Summary.

1. Most of the inspection laws are especially aimed at the detection and destruction of the San José Scale.

2. Inspections are of great value, but certificates are not proof that no scale exists in the nursery.

3. Nurserymen should either destroy all left-over stock or treat it before setting out in nursery rows.

4. The orchardist should also apply some treatment to the trees before planting permanently in the orchard.

5. Fumigating with hydrocyanic acid gas is the surest and cheapest method of destroying the scale upon nursery stock, but great care must be taken in using the gas, as it is very poisonous.

6. Spraying with kerosene and water or with a solution of whale-oil soap, as described above, is also effectual, and is the treatment to be advised for large trees in the orchard.

ON THE EFFECTS, ON TOBACCO, OF SHADING AND THE APPLICATION OF LIME.

By W. C. Sturgis.

In our Report for 1898 the disease of tobacco known as "Calico" was discussed as fully as the data at hand then warranted, and the reader is referred to the summary on pages 252 and 253 of that Report, for detailed information upon our knowledge of the subject up to that time. It is there stated that two principal and widely divergent theories regarding the cause of the disease have been advanced, viz: bacterial infection, and causes of a purely physiological character. Furthermore it was stated that the arguments in favor of the latter view seemed more weighty than those in favor of the former, although little, if anything, had been done to determine the precise nature of the physiological cause. Since 1898, however, efforts, apparently successful, have been made to determine this point, principally by Mr. A. F. Woods of the U. S. Department of Agriculture. The conclusions reached by Mr. Woods may be summarized as follows:* Calico (the "Mosaic disease" of foreign writers) is due to the concentration in the leaves of an excess of a chemical ferment known as an oxidizing enzym. This substance occurs in the soil and, in small quantities, in many of the higher plants. When especially active or present in large quantities, it produces a variegation of the leaves and other symptoms of disease owing to its destructive action upon the green coloring matter and its capacity for retarding the free passage of starch through the diseased cells and consequently the activity of their growth.

The concentration of the enzym in the leaves, or in certain portions of them, is due to "unsuitable soil nourishment, and very moist soil with little light, accompanied by atmospheric conditions stimulating rapid growth. It is especially favored by poor or weak seed." The investigations of Mr. Woods show that the disease is infectious and that it can be produced by cutting back vigorous tobacco plants, withholding additional plant-food and stimulating the active growth of the resulting

* See Centralblatt f. Bakteriologie, II Abth., Bd. V, No. 22, p. 750. (1899.) Science. New Ser., Vol. xi, No. 262, p. 17. (1900.)

suckers by a copious supply of water, a high temperature and partial shade.

This theory, which partakes of the nature of direct proof of the cause of calico, renders still more improbable the theory of bacterial infection in this case, and the question may be considered as relegated from the domain of the student of parasitic diseases to that of the physiological chemist. Nevertheless it is apparent that the methods recommended in our Report above referred to, page 253, for the prevention of calico, have not lost their significance as a result of the conclusions reached by Mr. Woods. Thus the sterilization of the soil in the seed-bed, on the supposition of the bacterial nature of the infection, would also be advisable on the enzym theory, since a temperature of less than 200° F. is sufficient to inhibit any further action on the part of the enzym. In the same manner the application of lime to render the soil more porous would, on this theory, be of value, as also would partial shading or any other device to bring about more equable atmospheric conditions and consequently a more even and regular process of growth.

In order to test the effects of lime and shading on the growth of the tobacco, the prevalence of calico and the quality of the finished product, permission was asked for and received from Mr. W. K. Ackley of East Hartford, to use a portion of his tobacco-land for this purpose. The soil was a close, clayey one, packing hard after a rain and requiring constant tillage; soil characteristic of the East Hartford tobacco lands where calico prevails. The piece selected for the experiment differed in no way from that of a large tobacco field immediately adjoining it, except that it had previously been used as a garden and had never borne tobacco. Our object being to test the effect of partial shade in connection with varying amounts of lime, it was decided to lay out the land in two long plots running north and south, with a six-foot alley between them, and to shade the western plot with screens made of laths. These two long plots were divided into four smaller ones, running east and west and separated from one another by four-foot alleys. To these plots it was proposed to add lime in varying quantities, from 300 pounds to 2,000 pounds per acre. Otherwise they were to be fertilized with barn-yard manure and fertilizer chemicals, as in ordinary tobacco culture. Each of the

smaller plots measured 39 feet by 14 feet, giving an area for planting, exclusive of the alleys, of 33 feet by 10 feet. This area would take 80 plants set 22 inches apart, in rows 3 feet 4 inches apart; of these 80 plants, 40 would be shaded and 40 unshaded, and each set of 80 plants would receive a different quantity of lime, from a quantity which might be considered as hardly appreciable up to one which would certainly be excessive.

On April 24th the lime was weighed out on the basis of 300 pounds per acre of quick lime for Plot I, 500 pounds per acre for Plot II, 1,000 pounds per acre for Plot III, and 2,000 pounds per acre for Plot IV.* Each quantity so calculated and weighed out was mixed with a large bulk of damp sand in order to ensure its even application and half of it was at once applied broadcast to the plot, the remainder being kept for application after the manuring and ploughing of the land, the object being to get the lime as evenly and thoroughly mixed with the soil as possible to a depth of at least eight inches. On May 18th fine stable manure was applied at the rate of about eight cords per acre, and the land was ploughed shallow. On June 5th the land was ploughed to a depth of eight inches, the remainder of the lime was applied in the same manner as before and, after the addition of a fertilizer as a "starter," the surface was thoroughly harrowed. The following day a frame-work of scantling was nailed upon posts previously set at a distance of two feet from each corner of the plots to be shaded and upon this were nailed laths at intervals equal to the width of a lath. The screen thus formed cut off one-half of the direct sunlight and was at a height of five feet from the ground. Doubtless a less cumbersome and expensive method of screening might have been adopted, but fears were expressed that movable screens of light material and construction might be blown down and inflict damage on the tobacco and it was deemed inadvisable to run any risk of this nature. Moreover it should be added that the experiment was planned not so much in order to obtain immediate results of commercial value, as to secure some indications regarding the methods which might be employed with advantage in future work along the same lines. The matter of cost was therefore rather a secondary consideration.

* The lime was air-slacked when applied.

Owing to dry weather the plants were not set until June 13th. They were watered the following day and from that time they all received ordinary seed-leaf culture.

During the period of growth, at least until after topping, it was very noticeable that the shaded plants were making much less growth than the unshaded ones; the leaves also were thinner, larger and darker green. The observations upon the prevalence of calico made at the close of the season may be summarized as follows:*

Unshaded Plots.

Plot I. Lime @ 300 lbs. per acre.	1 plant with top decidedly calicoed. 2 plants with tops slightly calicoed. 1 plant about three-quarters calicoed.
Plot II. Lime @ 500 lbs. per acre.	5 plants with tops decidedly calicoed. 2 plants with tops slightly calicoed.
Plot III. Lime @ 1000 lbs. per acre.	No calico observed.
Plot IV. Lime @ 2000 lbs. per acre.	1 plant showed the three top leaves "rusty." This appearance not identified with calico.

Shaded Plots.

Plot I. Lime @ 300 lbs. per acre.	2 plants with tops decidedly calicoed.
Plot II. Lime @ 500 lbs. per acre.	1 plant with top decidedly calicoed.
Plot III. Lime @ 1000 lbs. per acre.	1 plant with top decidedly calicoed.
Plot IV. Lime @ 2000 lbs. per acre.	2 plants showed the top leaves "rusty." This appearance not identified with calico.

The following table shows the total percentage of calicoed plants on each plot, shaded and unshaded:

	Lime per acre.	Unshaded.	Shaded.
Plot I	300 lbs.	10%	5%
Plot II	500 lbs.	17.5%	2.5%
Plot III	1000 lbs.	0	2.5%
Plot IV	2000 lbs.	0	0

* It is to be noted that calico was very prevalent in all of the tobacco fields in the neighborhood.

Had this experiment been conducted on a larger scale and had the above results been maintained, no one would have hesitated to pronounce the use of lime at the rate of 1,000 pounds per acre to be most effective in diminishing the amount of calico. The experiment, however, was on too small a scale to be considered as a proper basis for any final judgment. Nevertheless it does indicate a very close relation between the preventive means recommended on purely theoretical grounds and the practical results attained by the use of those means. The cause of the "rustiness" observed on the top leaves of some of the plants in Plot IV was not investigated further than to ascertain that it was not due to the attacks of either insects or fungi. It had every appearance of being a physiological trouble and, of course, from the practical standpoint of damage caused to the leaves, is quite as obnoxious as calico. The effect of this excessive application of lime upon the finished product will be discussed later.

On comparing the shaded with the unshaded plots it is evident that on the whole there was less calico on the former than on the latter, the difference in the case of Plot II amounting to 15%. The use of lime at the rate of 500 pounds per acre has exerted no favorable action as regards the prevalence of calico, but under these conditions the beneficial effect of partial shade is very apparent.

There are other factors to be considered in connection with the shading of tobacco, the principal ones being the effect of shade upon the growth of the plant and upon the quality of the leaf. As has been said, the growth of the shaded plants was markedly slower than that of those in the open. This held good until the plants were topped. The shaded plants showed the bud lower down than the unshaded and were therefore topped unnecessarily low; but after topping, the plants filled out and produced unusually large leaves, remarkable besides for their thinness and their very dark color. Another peculiar effect, apparently due to the shading, was the abundance of the so-called "natural spots." While not more than one or two of the unshaded plants showed them, fully 30-40% of the shaded plants were liberally sprinkled over with the small, pale, whitish spots of dead tissue so welcome to the eye of the buyer.

Evidence of the slow growth of the shaded tobacco is seen

in the fact that the unshaded plants were ripe and ready to be cut on August 19th, while the shaded plants could not be cut before September 1st, and from later observations it seemed doubtful whether they had not, even then, been cut too soon. The plants were cut and hung entire without splitting the stalk.

On November 1st they were all taken down and the leaves stripped off and weighed. The following table shows the number of plants from each plot and the weight of the leaves.

	Shaded.		Unshaded.	
	Number of Plants.	Weight of Leaves.	Number of Plants.	Weight of Leaves.
Plot I	39	9.5 lbs.	38	13 lbs.
Plot II	35	9.5 lbs.	40	14 lbs.
Plot III	43	11.5 lbs.	43	14 lbs.
Plot IV	38	11.5 lbs.	40	14 lbs.

The difference in the weight of cured leaves from the shaded and the unshaded plots is very marked. The total weight of leaves from the 155 shaded plants is 42 pounds; from the 161 unshaded plants, 55 pounds. The stalks also, of the shaded plants were noticeably smaller and lighter than the others, a fact due in great measure to lower topping. Whether the increase of weight with the increased quantities of lime applied has any significance, I am not prepared to state. It is noticeable in both series of plots, especially in those shaded. As to the comparative quality of the leaves after curing it was remarked that the leaves from the shaded plots cured darker and with a greenish cast (the latter possibly due to the plants having been cut before they were fully ripe), that they were thinner in texture and that the veins were lighter in color and more prominent than in the case of the unshaded tobacco.

The apparent thin texture of the leaves from the shaded plants is made more evident by exact measurements. For this purpose leaves were selected from each set of plants a few days after they had been hung in the curing-barn and, from cross-sections taken in at least five different parts of each leaf, measurements were made showing the exact average thickness of each leaf and of its component parts. In order to understand

the significance of these measurements it is necessary to consider briefly the microscopic structure of a tobacco leaf as shown in Plate II, facing page 264. The upper surface is composed of a single layer of cells and forms the *epidermis;* the upper walls of these cells are considerably thickened and form a practically impervious layer known as the *cuticle.* Beneath the epidermis is seen a layer of columnar cells filled with round granules, the so-called "chlorophyll grains," which, by their green color visible through the transparent epidermis, give to the leaf its characteristic color. These cells compose the *palisade layer* and it is in them, through the agency of the chlorophyll grains, that most of the assimilative activity of the leaf takes place. Below the palisade layer is a loose tissue composed of cells which also contain chlorophyll, but in much smaller quantity than the palisade cells; these cells, known collectively as the *"spongy parenchyma,"* conduct the products of assimilation from the palisade cells to the bundles of vessels and long cells which compose the veins; in them may here and there be seen stellate masses of crystals of calcium oxalate. The veins, for the sake of clearness, are omitted in the plate. Finally, the lower surface of the leaf, like the upper, is covered by a layer of epidermal cells; but here the epidermis possesses numbers of small openings or pores called *stomata,* through which the outside air has access to the internal tissues of the leaf. Both surfaces of the leaf are beset with large hairs arising from the epidermis.

With some understanding, then, of the structure of the various parts of the tobacco leaf, we may consider the effect of partial shade upon the thickness of the growing leaf.

The following figures represent, as stated above, the average of a number of measurements of sections taken at different points. The leaves selected were as nearly representative as possible.

	Shaded.	Unshaded.
Upper Epidermis	19.5μ*	28.5μ
Palisade Layer	153.3μ	234.7μ
Spongy Parenchyma	106.5μ	146.3μ
Lower Epidermis	16.1μ	18.8μ
Total thickness of Leaf	295.4μ	428.3μ

* The sign μ stands for $\frac{1}{1000}$ of a millimeter. 1 millimeter = $\frac{1}{25}$ of an inch.

The total thickness of the leaf has been decreased, by shading, by over 30%; the upper epidermis by 31%; the palisade layer by 35%; the spongy parenchyma by 27%; the lower epidermis by 14%. This reduction in the thickness of the leaf was not, in the present instance, regarded as wholly advantageous by the growers, a view which may be partly explained by the fact that the grower naturally desires weight, while it is the buyer who is concerned chiefly with quality. It is difficult to see why a thick leaf is to be preferred to a thin one, providing, of course, that the latter retains the degree of firmness and elasticity essential in wrapper-tobacco. As a matter of fact, the growers of tobacco in Florida have gone to enormous expense in shading their plants in order to produce a leaf which shall, among other things, be exceptionally thin, such tobacco commanding a very high price.

However, it may be said that even should this method be capable of producing a leaf for which the buyers would give fancy prices, the expense of erecting such screens as I have described above would be prohibitive, at least under present conditions.

The purpose of the present experiment, so far as the shading was concerned, having been merely to note the effect of the latter upon the prevalence of calico, nothing further need be said here relative to its effect upon the texture and quality of the leaf. That shading may reduce the amount of calico, there seems good reason to believe.

The following summary, kindly furnished me by Mr. Ackley, represents his running comment upon the shaded tobacco up to and including the period of curing:

1. The tobacco on the shaded plots grew much more slowly than in ordinary field-culture.

2. It had a very dark green color all through the season.

3. It showed the bud low; after topping it filled out to a very large-sized leaf.

4. During all stages of growth it maintained a very thin leaf.

5. It cured dark in color, with a greenish cast, prominent veins and very thin flesh.

6. In order to mature fully under screens, tobacco needs to be set very early.

After the tobacco was cured, the leaves were stripped off,

those from each plot were tied up separately and the whole was packed in boxes for shipment. On December 11th it was sent to the warehouse of Messrs. Sutter Bros. in East Hartford, and was there subjected to a forced sweat. On February 13th it was taken out of the case, although it was not completely sweated, and was submitted to experts for examination as to the quality of the separate lots respectively. The following represents the results of this examination:

Unshaded.

Plot I.

Texture, poor, good grain. *Color*, fair. *Size*, medium. *Vein*, very prominent, wiry, curly. *Stem*, very prominent. *Quality*, very poor.

Plot II.

Texture, rather poor, good grain. *Color*, good. *Size*, medium. *Vein*, fairly prominent, wiry. *Stem*, fairly prominent. *Quality*, poor.

Plot III.

Texture, very good, very pronounced grain. *Color*, very good. *Size*, medium. *Vein*, desirable, not wiry. *Stem*, fair. *Quality*, very good.

Plot IV.

Texture, fair. *Color*, good. *Size*, medium. *Vein*, fair, a trifle curly, tends to "white-vein." *Stem*, fair. *Quality*, good.

Shaded.

Plot I.

Texture, thin, no grain. *Color*, poor, not fully sweated, shows some "rust." *Size*, large. *Vein*, fairly prominent, wiry. *Stem*, not desirable. *Quality*, poor.

Plot II.

Texture, thin, no grain. *Color*, poor. *Size*, large. *Vein*, prominent, somewhat wiry. *Stem*, prominent. *Quality*, rather poor.

Plot III.

Texture, thin, not elastic, no body, no grain. *Color*, poor. *Size*, large. *Vein*, prominent, wiry, curly. *Stem*, prominent. *Quality*, very poor.

Plot IV.

Texture, fair, no grain. *Color*, fair, (not ripe). *Size*, large. *Vein*, rather prominent, tends to "white vein." *Stem*, fairly prominent. *Quality*, fair.

The tobacco, on the whole, was pronounced of poor qualtiy; that from the unshaded plots was coarse, with harsh and wiry veins; that from the shaded plots was objected to as having been immature when cut and consequently of very poor color and of so thin and smooth a texture as to be practically worthless. It was noticeable that in the case of both the shaded and the unshaded tobacco the plots which received the largest quantity of lime (IV) showed a good deal of "white-vein." The best of the unshaded tobacco was adjudged to be that from Plot III, which had received lime at the rate of 1,000 pounds per acre. The best of the shaded tobacco was that which received lime at the rate of 2,000 pounds per acre. On the whole, the shaded tobacco was pronounced far inferior to the unshaded. This latter opinion did not prove to be shared universally; one expert buyer, who knew nothing of the history of the tobacco, pronounced in favor of the shaded tobacco, both as regards texture and quality.

A sample of the leaves from each plot was brought to New Haven and the character of the ash was tested. None of the tobacco, when rolled on a cigar and smoked, gave a good ash. The best was, without any question, the unshaded tobacco from Plot III. It is the general opinion among growers that the use of lime tends to produce a flaky ash, yet the tobacco from Plot III, which received lime at the rate of 1,000 pounds per acre, gave a smoother, whiter and firmer ash than that from Plot I, which received only 300 pounds per acre. No difference could be observed, as regards the character of the ash, between the tobacco which had the least amount of lime and that which had the most; in both cases the ash was grey, flaky and deficient in firmness. The burn of the tobacco from all of the plots was equally poor.

This experiment, inconclusive as it proved, opens up a number of interesting possibilities, not the least of which is that the use of lime may not, in all cases, exercise the deleterious effect on tobacco that some growers suppose it to, and that there is some reason for thinking that its use may tend to decrease the prevalence of calico.

ON THE SO-CALLED "GRAIN" OF WRAPPER TOBACCO.

By W. C. Sturgis.

It is a well-known fact that tobacco leaves used as wrappers, frequently exhibit, after curing, numbers of minute, blister-like pimples thickly scattered over the surface of the leaf and giving to the latter a somewhat granulated appearance and a roughish feeling quite different from that due to the hairs which beset the surface. This "grain" occurs on all kinds of tobacco which I have examined, viz. domestic, Sumatra and Havana, but in very varying degrees. Sometimes, especially in the finer grades of Havana tobacco, the "grain" is almost entirely absent; in other cases it is so prominent as to be distinctly visible to the naked eye, and it then gives to the ash a peculiar appearance which will be described presently. So far as I know, the cause of the "grain" has never been investigated, but the idea prevails among Connecticut tobacco growers that it is either in itself a desirable feature in the leaf or that its presence is indicative of superior quality. A cross-section of a tobacco leaf at a point occupied by one of these minute blisters shows, by means of the microscope, that the blister is caused by a dense deposit of some crystalline substance in the cells of the leaf. These deposits are sometimes so large that they equal or even exceed the thickness of the fresh leaf, and consequently when the leaf shrinks in drying the "grain" becomes apparent, often causing the rupture of the epidermis. If the deposit is small it does not, of course, become visible superficially, but only in the microscopic section; if smaller still, it becomes indistinguishable from the stellate aggregations of crystals which frequently occur in the cells of the spongy parenchyma of the leaves of tobacco as well as of many other plants. (See Plate II, page 264.)

If one of these large crystalline deposits is more closely examined, it is seen to be composed either of extremely minute particles or of radiating clusters of very fine, needle-like crystals. The latter form is characteristic of the deposit when it occurs in the ordinary cells of the leaf, while if it occurs in the large cells and vessels of the veins the deposit is composed of particles. In such cases the vessels, while retaining their original

form, become practically petrified and may then be dissected out in the form of brittle rods. This crystalline substance presents the following reactions in microscopic sections. It is insoluble in water, but readily and completely soluble in dilute hydrochloric acid.* On heating (ascertained by lighting the leaf and watching the effect of the advancing heat upon an individual "grain") the deposit swells to three or four times its original volume and becomes distinctly visible on the cigar-ash. If the "grain" is prominent and abundant, the ash is seen to be roughened all over with little grey lumps. On removing some of these from the ash to a glass slide, and treating them with dilute hydrochloric acid, they are at once dissolved with copious evolution of gas.

These observations, coupled with what we know of the frequent occurrence of oxalate of lime in normal leaf-tissues, leads to the conclusion that the "grain" of tobacco-leaves is caused by the excessive deposition of this substance in limited areas of the leaf. Upon heating one of these deposits, it swells and becomes converted into carbonate of lime, which dissolves in hydrochloric acid and gives off bubbles of carbonic dioxide. This being the case, one might suppose that the addition of lime to the soil would make the "grain" of the cured tobacco more prominent. That this is not the case, however, was made evident by the results obtained from the use of lime in varying quantities in the experiment described on pp. 252 to 261 of this report. The "grain" on the cured leaves from plot I, which received the smallest quantity of lime, was very small; on the leaves from plot II it was abundant and prominent; on III it was fairly prominent; and on IV, which received the largest quantity of lime, the "grain" was even less marked than in the case of I. These plots were all grown in the open field. On the shaded plots the leaves, after curing, showed practically no "grain" whatever. This was especially true of the intermediate plots II and III. On the leaves from plots I and IV the "grain" was either wanting or so minute as to be plainly visible only under a lens. In this case, then, the use of lime has had no appreciable effect on the "grain." The only conclusion in this

* Dr. Loew, of the U. S. Department of Agriculture, informs me that it yields, after treatment with sulphuric acid, numerous crystals of calcium sulphate.

respect which can be deduced from the experiment is that shading produces a leaf remarkably deficient in "grain," notwithstanding the fact that the thin texture of the shaded leaves would have made the "grain" more prominent had the deposits of calcium oxalate been present to an equal degree as in the unshaded leaves.

As to the question of whether the "grain" is formed during the process of curing or is present in the growing leaves, nothing definite can be said as yet. It is quite conceivable that after the plants are cut and hung, the leaves might draw from the stalk dissolved mineral matter which might later, as the sap dried out, be deposited in crystalline form within the cells. On the other hand, the deposits might exist in the growing leaf and yet not be visible externally as a "grain" until the shrinkage in thickness of the leaf, while curing, made them apparent. I am inclined to take the latter view of the case and to presume that, given a certain quantity (not necessarily a large one) of lime in the soil, tobacco plants, under certain conditions, may take it up in quantities far greater than they can utilize; that the excess is consequently deposited in crystalline form in the tissues, and that it produces a visible "grain" only after the shrinkage in thickness incident to the process of curing.

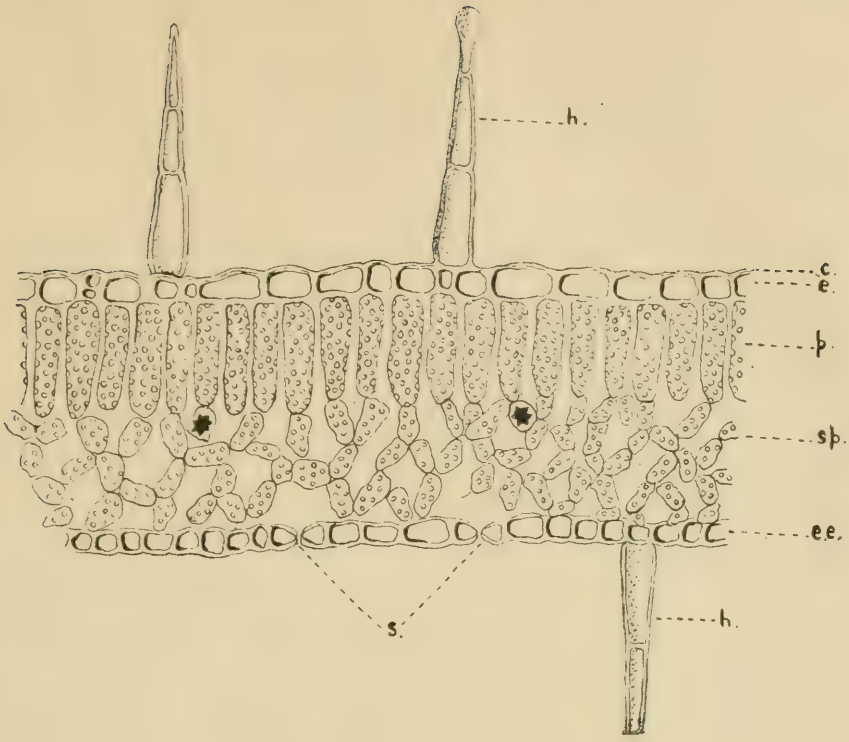
EXPLANATION OF PLATE.

Fig. 1. Cross-section of fresh Tobacco-leaf, highly magnified: c, *cuticle;* e, *upper epidermis;* p, *palisade layer* with *chlorophyll grains;* sp, *spongy parenchyma* with two crystals of oxalate of lime; ee, *lower epidermis;* s, *stomata;* h, *hairs.*

Fig. 2. Cross-section of cured Tobacco-leaf, showing the masses of needle-like crystals of calcium oxalate which cause the "grain." The contents of the cells are disintegrated and the leaf is much reduced in thickness. A vascular bundle densely charged with a crystalline deposit traverses the median line of the section. Magnified 105 diameters.

Fig. 3. Portion of a vascular bundle filled with crystals. Partly decalcified by treatment with dilute hydrochloric acid. Magnified 330 diameters.

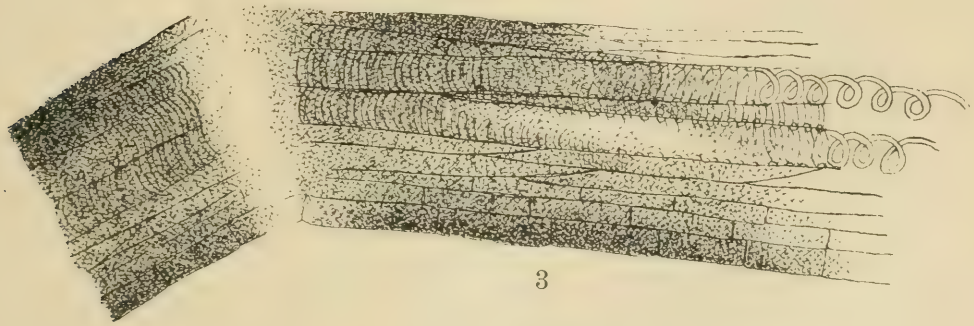
Fig. 4. Isolated crystals of oxalate of lime from the vessels of the same bundle. Magnified 680 diameters.



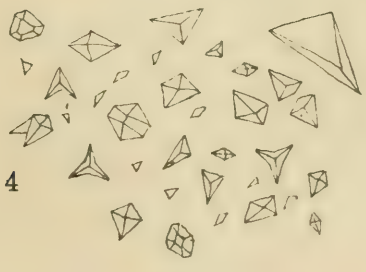
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FURTHER NOTES ON THE POLE-BURN OF TOBACCO.

By W. C. Sturgis.

In the latter part of August of the past year, some tobacco-leaves showing the initial stages of pole-burn were brought to the Station by Dr. E. H. Jenkins. It has not proved an easy matter in the past to make any really conclusive observations upon this disease owing to the fact that growers naturally hesitate to proclaim the fact of its appearance, and also because, by the time the fact becomes known and an investigation can be instituted on the spot, the trouble has progressed so far that secondary changes have occurred which, more or less, prevent any accurate determination of the primary cause. Thus, in my first study of the subject in 1891 (Annual Rep., Conn. Agr. Exp. Station, 1891, pp. 168-173), the trouble had progressed so far that a process of decay had set in, and from the surface of the leaves a number of putrefactive bacteria could be isolated as well as a fungus of the genus *Cladosporium.* This same fungus developed upon partially cured, but hitherto sound, tobacco-leaves hung up in a warm, moist atmosphere, and this was in turn followed by the growth of bacteria in the spots affected and the consequent decay of the leaves; nevertheless there was no certainty regarding the initial stage of the trouble. It was therefore of extreme interest to secure specimens in which "pole-burn" had evidently but just started.

The leaves collected by Dr. Jenkins presented the normal appearance of partially cured tobacco, with the exception that here and there, especially in the neighborhood of the larger veins, the tissues were of a darker color and extremely tender. The surface of these irregularly circular, dark blotches was dull as compared with the silky lustre characteristic of the sound portions of the leaf, and in some cases a delicate, whitish mold could be seen upon them. Microscopic examination of this mold showed that it was a species of *Alternaria,* but none of the spores observed were mature and evidently the fungus had been checked in its earlier stages of growth by being brought into the laboratory and allowed to dry. The most rigid examination of the surface of these diseased blotches, made by allow-

ing a drop of water to stand upon them for half an hour and then transferring it to a glass side, failed to demonstrate the presence of any organisms on the leaves except the immature fungus above-mentioned. A similar result followed the direct examination of scrapings from the surface. It is evident, however, that such rough methods of research by no means preclude the possibility of bacterial infection. Unless bacteria existed in a vegetative form and in very great numbers on the surface of the leaves, their presence might be extremely difficult to prove by direct examination, while if, as is quite possible, they existed in the internal tissues, the epidemis remaining unruptured, they might not appear upon the surface at all.

In order to gain some information regarding the organisms associated with the initial stages of pole-burn, and incidentally regarding their location within or upon the leaf tissues, recourse was had to fractional plate-cultures in broth-gelatine.

From portions of the leaf showing the symptoms of disease noted above, circular bits of tissue, 1.5 cm. in diameter, were cut out with a sterilized knife. One of these was rinsed in absolute alcohol to destroy, as far as possible, all germs of bacteria or fungi upon the surface of the leaf, and was then thoroughly washed in sterilized, distilled water in order to remove the alcohol; the other received no antiseptic treatment. Each sample was then thoroughly macerated in a little sterilized water. A drop or two of this water was then added to 10 cc. of sterilized water in a test tube, and thoroughly shaken; from this tube a few drops were transferred to a tube of broth-gelatine melted at 35° C. The contents of this tube were then poured into a Petri dish; into the same tube were poured the contents of another tube of broth-gelatine, and so on, using the first tube each time as the source of infection, until six plate-cultures had been prepared from each sample of macerated leaf. These cultures, if successful, would evidently show what germs were associated with the leaves, and also whether they occurred on the surface only or were also to be found within the tissues where the treatment with alcohol could hardly affect them.

It is quite unnecessary to recount here the history in detail of these cultures. They were started on November 8th. On the 13th of that month the first plate in the series made from the untreated leaf showed a little mold. On the 23rd this

mold had increased to such an extent as almost to cover the surface of the gelatine; there were also in this plate one or two small colonies of yeast. The second plate in this series showed on the same date a large growth of yeast, but very little of the mold. The other plates of the series remained blank. The mold proved to be a species of *Alternaria* identical with that observed, by direct examination, on the surface of the leaf.

The series of cultures made from the leaf which had been rinsed in absolute alcohol differed from the other series in the complete suppression of the *Alternaria* and in the development in considerable quantities after ten days, of a large *Bacillus.* As in the first series, this occurred only in the first two plates of the series, a fact indicative of a rather scanty distribution of germs either within or upon the leaf. The only organisms developed in connection with the pole-burn were then, in this instance, a species of *Alternaria,* a *Yeast* and a *Bacillus.* The first named occurred only on the surface and did not, therefore, appear in the cultures from the leaf sterilized superficially with alcohol. The same is true of the yeast; but the bacillus occurred only in the cultures from the sterilized leaf and the inference therefore is that it was present within the tissues only.

Two months later these cultures were repeated with the addition of a series made from a bit of leaf doubly sterilized, viz. by rinsing in alcohol and then in formalin. In these three series it was again only the first plate of each which developed anything worthy of note. As a rule, the other plates either remained perfectly blank or else developed after at least a week, one or two small mold colonies near the edge, which might well have been due to outside infection.

From the doubly sterilized leaf there developed in the course of ten days one large, radiating, liquefying colony of small, motile rods of the type of *Bacillus subtilis,* which we may call *Bacillus I;* three smaller, flocculent, liquefying colonies of very large rods related to *B. megatherium,* which may be designated as *Bacillus II;* a few pin-head, moist, non-liquefying, tawny colonies of a *Micrococcus;* and one large, white, sterile mycelium near the edge. This would seem to be a remarkable result to obtain from a piece of leaf-tissue subjected to the combined action of such powerful germicides as alcohol and formalin. As a matter of

fact, however, it was only the first plate in the series which showed any growth whatever; that growth consisted of no more than fifteen or twenty colonies representing a similarly small number of germs; and finally, the leaf from which the cultures were made had been lying for several months on a laboratory table, protected only by a bell-jar. Under such conditions there was abundant opportunity for many bacterial spores capable of resisting the germicides used, to have collected upon the leaf and to have been transferred thence to the culture-plates. It may fairly be said that the cultures from the partially sterilized leaf presented no grounds for concluding that either bacteria or fungi were present within the tissues in sufficient numbers to account for the extensive damage wrought by pole-burn. Had they been so they would almost certainly have occurred in overwhelming numbers, not in the first dilution-culture merely, but in one or more of the subsequent ones.

The same general remarks apply to the series made from a portion of the leaf treated with alcohol only. Here the first plate yielded, after ten days, two small colonies of *Bacillus I,* two of *Bacillus II,* many of the *Micrococcus,* but all extremely small, and in addition, four small tufts of *Aspergillus* and *Penicillium.* Here again, there is no evidence to show that the internal tissues of the leaf contain any organism in quantity sufficient to produce the decay accompanying pole-burn.

As in the previous cultures, however, when we come to the cultures made from the leaf in its natural condition, we do find one organism appearing constantly and abundantly. After ten days the first dilution-culture contained small colonies of *Penicillium, Cladosporium, Fusarium, Bacillus II,* and another smaller, very active bacillus, liquefying rapidly, and of a pale straw-color. But overrunning all of these was a very abundant growth of brown mycelium, starting in at least eight different centres, and consisting entirely of the *Alternaria* before-mentioned.

I can only conclude from these cultures that, as far as regards the organisms associated with the earliest stages of pole-burn, this species of *Alternaria* is the only one which occurs in any abundance, and that it occurs only on the surface of the leaf, not in the internal tissues. These remarks must be understood to apply strictly only to the case in hand. Some years ago

I stated, as the result of some preliminary investigations upon the subject, that pole-burn was, in my opinion, due to an excessively damp atmosphere, inducing the growth of a fungus at certain points on the tobacco leaf, this being followed by a process of decay in which a species of *Bacillus* and a species of *Micrococcus* were the principal factors.* The fungus which was associated with the trouble was, in that instance, unquestionably a species of *Cladosporium;* in the present instance it is as certainly a species of *Alternaria.* These statements are not, as might appear, contradictory. They merely indicate that, under certain atmospheric conditions, any saprophytic fungus which may be present in the curing-barn may attack the dead tissues of the leaves and start in them a process of disintegration which will almost surely be followed by true bacterial decay. It is interesting to note in this connection that the predominant forms of bacteria which occurred in the cultures during the investigations just described, were apparently identical with the large *Bacillus* and the *Micrococcus* observed in the similar case eight years ago.

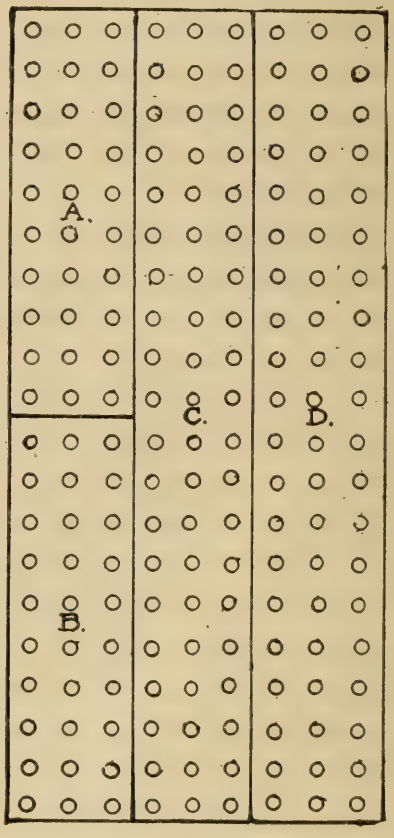
It is perhaps necessary to say in conclusion, that these further observations upon the cause of pole-burn confirm the suggestions regarding remedial measures made in our Report for 1891, p. 173, *e. s.*

* See Conn. Agr. Exp. Station, Rep. for 1891, pp. 170 and 171.

ON FRACTIONAL FERTILIZATION OF MELONS AS A PREVENTIVE OF DISEASE.

By W. C. Sturgis.

In the Report of this Station for 1898, pp. 230-232, an account was given of the favorable results attending the use of tobacco stems as a mulch for melon-vines. The advantage which the vines derived from this treatment was seen in a general increase of vigor owing to the gradual supply of plant-food made a available by the slow decay of the tobacco-stems. It occurred to me at the time that at least a part of the failure which has recently become so marked a feature of the melon-growing industry in Connecticut might be due to the fact that the whole of the plant-food was supplied at the beginning of the season, and that by the time the fruit began to form, especially if heavy rains had intervened, the available supply was so far exhausted that the vines suffered from partial starvation and were therefore very susceptible to fungous attack and other injurious agencies.



An experiment was therefore planned to test the effect of small applications of plant-food from time to time throughout the growing season. For this purpose a portion of a melon-field was selected at North Haven on the farm of Mr. H. P. Smith, who has in the past so kindly offered us similar facilities for experimental work. The melons occupied a large upland field with a slight slope to the eastward. The soil was dry and sandy. The portion selected for the experiment was near the center of the field and consisted of nine rows, each containing twenty hills. This area was divided into three sections of three rows each and one of

the sections was again subdivided into two as seen in the accompanying cut. These plots, like the remainder of the field, received the usual manuring, viz., a fork-full of compost, consisting of barnyard manure and tobacco-stems, placed in the hill at the time of planting; they all received the same culture throughout the season.

The plants made a good growth, and on July 1st were equally thrifty all over the field. Early in July the plots were staked out, and a fertilizer was prepared, consisting of muriate of potash, 13 lbs.; nitrate of soda, 41 lbs.; dissolved bone-black, 10 lbs. This was in the proportion of 4 parts of potash, 4 parts of nitrogen, and 1 part of phosphoric acid. On July 12th, when the vines were just beginning to show flowers and the runners averaged about two feet in length, the fertilizer was applied to plots A and B. The method of application was to scatter a handful of the fertilizer, thoroughly mixed, on the surface of the soil around each hill, at a distance of about ten inches from the center of the hill. On August 10th a like application was made on plots B and C. At this time the ground was fairly covered by the vines, fruit was setting in abundance, and the vines throughout the field showed a fine color and were apparently thrifty and vigorous. A week later, however, there was a very different state of affairs. On August 17th a visit to the field revealed the fact that the whole field, with the exception of the fertilized plots, was of a uniform yellowish tone, in marked contrast to the dark green color of the portion which had received the additional fertilizer. It will be noted that plot A received but the one application in July, plot B received an additional application in August, plot C received only the August application, and plot D received nothing except the original supply furnished at the time of planting. No difference was observable on August 17th, as regards vigor, between plots A, B and C; but plot D showed the same yellow color observable in the field at large, with the exception of the single row adjoining plot C, which had evidently benefitted by its proximity to the extra food-supply on that plot. As to the weather conditions during July and August when the vines were blooming and producing fruit, and were consequently making increased demands on the fertility of the soil, heavy rains occurred almost continuously from July 22nd to July 29th, while from the latter

date until August 10th there was no rain. Two light rains then occurred, but no more up to the middle of the month, when the conditions described above and indicative of partial starvation were observed. The application of the fertilizer on July 12th was followed by rain, that on August 10th was made during a rain-storm. These weather conditions were such as to diminish, at a critical period, the quantity of soluble plant-food originally in the soil, particularly in the loose, sandy soil at present under consideration, and at the same time to render immediately available the later applications of fertilizer.

On August 17th much time was spent in a most careful examination of the vines throughout the field for evidences of any specific cause of disease, and specimens were collected for future microscopic examination. The result of this search was entirely negative. Here and there a vine was found affected by the wilt disease, and more frequently leaves were found which showed the initial stages of the spotting due to the fungus *Alternaria,* but neither of these was at all adequate to explain the sudden loss of vigor and marked change of color which characterized the plantation. Only on the fertilized plots was there no yellowing of the vines, no decrease of vigor, and no spotting of the leaves. The conclusion was almost irresistible that the trouble was to be found primarily in a deficiency of available plant-food and that the indications of actual disease were merely incidental. Part of the trouble might possibly have been prevented. The wet weather in the middle of July induced a very active growth of weeds and, owing to the pressure of other work on the farm, the melon-field was somewhat neglected, so that the weeds soon completely covered it. Undoubtedly part of the starved condition of the melon-vines was attributable to the luxuriant growth of the weeds; nevertheless on the experiment area, though it was covered with a rank growth of weeds, the vines retained a measure of vigor longer than in other parts of the field. As soon as the melons began to ripen it was found that they were of extremely poor quality, indeed they proved later to be almost worthless. This was partly due to the poor condition of the vines, and partly, as it appeared, to the fact that the quality of the seed was far below the average. The only melons which matured properly and were even of fair quality, were gathered from the experimental plots.

Through the kindness of Mr. Smith, a record was kept of the yield from these plots on August 25th, 29th and 31st. This record is given below. After the date last named the quality of the melons was so poor that no more were gathered.

		Aug. 25.	Aug. 29.	Aug. 31.	Total.	Remarks.
Plot A*	No.	94	52	260	406	Leaves slightly yellow on Aug. 23rd. All dead on Aug. 31st. Vines still green.
	Wt.	166 lbs.	94 lbs.	290 lbs.	550 lbs.	
Plot B*	No.	72	28	408	508	Leaves slightly yellow on Aug. 25th. Leaves and most of vines dead on Aug. 31st.
	Wt.	112 lbs.	46 lbs.	396 lbs.	554 lbs.	
Plot C	No.	—	92	0	—	Leaves very yellow and dying on Aug. 25th. All dead on Aug. 29th.
	Wt.	148 lbs.	273 lbs.	0	421 lbs.	
Plot D	No.	40	76	0	116	Leaves as in Plot C.
	Wt.	152 lbs.	233 lbs.	0	385 lbs.	

So many causes conspired to make this melon-crop a failure, that very little importance can be attached to the above figures. They do, however, indicate that the increase of vigor where the vines received additional plant-food during the growing season had its result in an increased production of fruit (cf. Plots A and D); that the additional advantage derived from two applications of fertilizer instead of one, was less than might be expected (cf. Plots A and B); and that a single application after the fruit was partly grown was of almost no value (cf. Plots C and D).

The fact that where additional fertilizer was applied there was almost complete absence of the wilt and the spotting of the leaves, is sufficient to warrant further experiments along this line.

* The yield of the half-plots, A and B, are calculated on the basis of a whole plot; that is, the actual yield of each plot is multiplied by two.

ON THE PREVENTION OF RASPBERRY-ANTHRACNOSE BY CULTURAL METHODS.

By W. C. Sturgis.

The disease of raspberries known as "Anthracnose," and caused by the fungus *Glœosporium necator*, Ell. & Ev., is unquestionably the most serious enemy with which the grower of raspberries has to contend. It is hardly necessary to describe this disease. The small, roundish blotches, light in color and bordered by a dark purplish ring, which appear on the young canes and produce on older canes irregular, scab-like areas, serve to identify the fungus at sight. Numerous experiments have been made to ascertain how the young canes become infected in the Spring, how they may be protected from infection and whether or not there is any practical cure for the disease after it is once firmly established on the old canes. Thaxter has shown (Conn. Agr. Exp. Sta. Rep. for 1889, p. 172) that "fresh shoots, developed from below the ground as well as from the old canes above and below the diseased spots, show no signs of the fungus." From this he concludes that the vegetative portion of the fungus does not spread from the old wood to the new growth, but that the latter is infected by means of spores produced in Spring on the old centers of disease, and that by cutting out and burning all of the old, diseased canes, the danger of fresh infection may be very materially diminished if not totally prevented.

The most extensive experiments upon the treatment of anthracnose by means of fungicides have been made at the New York Experiment Station, and are fully reported in Bull. 124 of that Station. These experiments show that it is possible practically to free a plantation of raspberries from anthracnose by cutting out and burning the old diseased canes and by protecting the new growth by frequent applications of Bordeaux mixture; but at the same time it is shown that spraying does not increase the yield and is therefore not profitable. As a rule a raspberry plantation attains its maximum of productiveness in its third year, and most growers follow the practice of renewing their plantations after this period. In such cases, providing that proper care is exercised in selecting or purchas-

ing new plants absolutely free from anthracnose, there is little danger of very serious injury from the disease. Sometimes, however, it becomes advisable to fruit a certain plantation for a longer period and then some means of holding the anthracnose in check becomes necessary. According to the New York experiments it does not pay to attain this end by spraying, but there can be little doubt that by certain methods of culture the disease can be checked, at least temporarily, providing that the atmospheric conditions are not too unfavorable, and that by such means a plantation which would otherwise represent a total loss can be made remunerative for a season or two. The following is a good illustration of such a case.

Early in April last, I received from Mr. G. C. Beckwith of Nepaug a bundle of very badly diseased raspberry-canes, accompanied by a letter, stating that they were taken from an acre of a very heavy growth of canes which showed no sign of disease the previous season, but at the time of writing included hardly a single healthy plant. In reply to inquiries and suggestions, Mr. Beckwith wrote later that the disease was so bad that if he attempted to cut it all out there would be nothing left, and he suggested the possibility of spraying the plants as they stood, getting what fruit he could, and then destroying the whole plantation. A visit to Nepaug showed that Mr. Beckwith's description of the condition of affairs was hardly exaggerated, nevertheless he was advised to cut out as many of the diseased canes as possible and to spray the remainder with Bordeaux mixture, in the hope that thereby a fair crop might be gathered before the plantation had to be given up as worthless. This course was recommended merely as a temporary expedient, with no idea that any permanent results would be attained. The outcome, however, was far more successful than had been anticipated. Under date of January 25th, 1900, Mr. Beckwith wrote as follows: "Sickness just at the time when spraying should have been attended to, prevented my doing this, and the canes were not sprayed at all. But I gave them a very severe pruning as you suggested. Then followed cultivation. I also hoed and drew the dirt up over the old diseased stumps. I kept up thorough cultivation until the time of fruiting. The result was, I had not only a rank growth of young canes, but a splendid crop of fruit. You will

remember that we both thought it would not pay to try to do anything with the plants further than to get the one crop of fruit, but the canes grew so rank and appeared so free from disease that I am going to try the same experiment again another year, for I am satisfied that it was the pruning and the thorough cultivation which did the work. I took about 500 plants from this piece and set them in another lot; although I sprayed them several times there is now a considerable amount of disease among them."

These results are not difficult to explain in retrospect, and they may not be so favorable again. The pruning removed most of the fungus; what was left on the canes was doubtless kept from spreading by the lack of rain throughout the past Summer; and the thorough cultivation enabled the young canes to maintain their general vigor. Had the season been even a normally wet one, the disease would probably have been much more apparent. Mr. Beckwith's experience with plants taken from the diseased area gives abundant evidence of the danger of starting a fresh plantation from such a source, even under the most favorable conditions. It is safe to prophesy that, whatever the condition of the old plantation may be during the coming season, the new one will certainly be diseased.

MISCELLANEOUS NOTES.

By W. C. Sturgis.

Downy Mildew on Melons. This mildew, known to botanists as *Plasmopara Cubensis,* is common upon cucumbers, especially under glass, but has been reported only once on melons in this State. That was in 1899 at South Manchester. It appears to be a common disease of both melons and cucumbers in New Jersey, New York and Ohio, and, besides these plants, it is known to attack the squash, pumpkin, watermelon, gourd, wild star cucumber (*Sicyos*), wild prickly cucumber (*Echinocystis*), and a number of other plants of the same family.

It was hoped that, with three serious parasitic diseases to diminish still further the continually decreasing returns from melon-culture in Connecticut, we might be relieved from the presence of a fourth, at least until some satisfactory means of dealing with the others had been found ; but in the latter part of August last, I received from Mr. F. T. Ives of Meriden a number of melon-leaves, accompanied by a letter stating that, a week before, the vines from which the leaves had been taken were in a perfectly healthy condition, but that at the time of sending the specimens, every leaf on the two-acre field was dead and dried up. Sixty or seventy dozen melons had been picked in this field, but the ground was still covered with fruit which, owing to the rapid spread and disastrous effects of the disease, would be practically a total loss. Mr. Ives was inclined to attribute the trouble to the attacks of some insect, but its rapid spread was indicative rather of fungous attack, and the microscope confirmed this supposition. The upper surface of the leaves showed numbers of roundish or triangular, yellowish spots and blotches, which, on the lower surface of the leaf, were seen to be covered with a small, white mold, very like that seen in the case of the downy mildew of the grape, and easily identified as the fungus above-mentioned. That this disease, though hitherto decidedly localized, may become widely spread and do very great damage, is shown by the statement made by Mr. Ives that in 1898 it attacked his melons when the fruit was on the point of ripening, and destroyed more than 10,000 of them. Evidently it differs from other common diseases of melons in the lateness of its attack, seldom

appearing before the fruit begins to ripen; in the unexpectedly sudden manner of its appearance; and in the rapidity of its progress, there being sometimes no more than a week intervening between the first evidence of the trouble and the total destruction of the plants over a large area. In these respects it resembles its near relative, the late-blight of potatoes (*Phytophthora*).

The same disease, as noted above, is liable to attack cucumbers, and very successful experiments in checking it on those plants are on record, but although similar experiments with melons have been tried, notably in Ohio,* they do not seem to have been attended by the same measure of success. One reason for this is doubtless that the cucumber crop is harvested early, before the mildew becomes a serious menace, while melons have to remain in the field until mature and are thus exposed to the attacks of the fungus for a longer period. Nevertheless partial success, and in one or two cases entire success, has followed the use of Bordeaux mixture as a preventive of this mildew. Evidently then, there are two available methods by which the damage from this trouble can be minimized; first, by starting the plants under glass, forcing the growth, and transplanting to a warm, rich soil, thus securing the crop of fruit early enough to prevent the vines from being attacked by the mildew; secondly, by growing them in the usual manner from seed planted in the open and affording the vines protection, when almost full grown, by the thorough application of Bordeaux mixture. By the first method there would be the added expense of forcing and transplanting, but there is every probability that this would be more than offset by the early maturing of the fruit, the higher price which it would command, and the freedom of the vines from mildew; the second method would involve the expense of spraying and might, even then, prove unsuccessful. The expense of spraying need not exceed $3.00 per acre for each application, and three thorough applications, beginning about the middle of July, should afford the highest possible degree of protection.

A Destructive Disease of Potatoes. About the middle of June I received word from Mr. J. W. Jennings of Southport that his potato-vines were blighting badly. The blight was

* Ohio Agr. Exp. Sta., Bull. 105, pp. 230–232, 1899.

described by Mr. Jennings as a kind of wilt, the plants attacked suddenly withering without apparent cause and very soon becoming brown and dead. The trouble started near the center of the field when the plants were about eight inches high, and attacked only three or four hills; it spread, however, with great rapidity, the affected area doubling or trebling in size in the course of three days. At the time of Mr. Jennings' letter, he reported that about a square rod was affected. I at once visited Southport and examined the diseased field. The whole field appeared thrifty except in the one portion described by Mr. Jennings. In the center of this portion the vines were completely dead and the blackened and shrivelled stalks alone indicated where the hills had been. Toward the margin of the area, which was almost circular, indicating a gradual spread of the trouble in all directions from a single center, the plants still showed signs of vigor, though badly wilted; farther still from the center, hills could be found in which only one or two of the stalks had begun to wilt, the remainder being perfectly healthy. It would seem a simple matter, with all stages of the trouble thus before the eye, at least to hazard a guess as to its nature; but after thorough examination of the plants in the field and of abundant material taken to the laboratory, I found myself no nearer a satisfactory explanation of the trouble than before. Examination of the wilted plants showed that the stalks were hollowed out from a point about 2–8 in. above the surface of the ground to an inch or so below the surface. These hollow stalks had every appearance, in most cases, of having been caused by insects, indeed in several cases they showed a small perforation near the crown of the root which apparently had served for the entrance or exit of the insect. In other cases, however, the hollows in the stalks were not continuous but showed numerous cross-partitions, so that it was difficult to associate their production with insects. Notwithstanding the similarity in appearance between these hollow stalks and the injuries caused by the potato stalk borers (*Trichobaris trinotata* and *Gortyna nitela*), the most careful search failed to reveal the presence of either of these insects. If the trouble had been due to either of these borers, it would have been next to impossible, at that season, to overlook the larvæ of the insect within the stalks.

On the other hand, in the material examined microscopically in the laboratory, nothing of a fungous or bacterial nature was found which could apparently account for the wide-spread destruction of the tissues in the stalk. The whole subject of the cause of the trouble was therefore reserved for another season's work. Meantime I had advised Mr. Jennings to gather all of the diseased vines into a pile and burn them, taking the extra precaution of including a hill or two beyond the apparently extreme limit of the affected area. This was done immediately, and, in addition, Mr. Jennings saturated the whole area with Paris green in water. No more trouble was experienced, and the field produced a fine crop of sound potatoes.

Serious injury to Peas. During the past Summer there were several complaints from different parts of the State to the effect that the pea-crop was proving a failure. The trouble was said to make its appearance at about the blossoming period, and as a result the vines became yellow, dropped their leaves, failed to mature pods properly and, in some cases, turned brown at the surface of the ground and rotted off. The description of the trouble recalled a common disease of peas which appeared with unusual severity in Germany a few years ago and was there made the subject of very careful and thorough investigation.* In this country the most serious of its attacks appear to have been in the pea-canning sections of Delaware.† The disease is caused by the leaf-spot fungus, *Ascochyta Pisi,* and usually does very little damage, being confined to a few of the leaves and pods. Occasionally, however, when the conditions are peculiarly favorable to it, it may become extremely active, destroying the crop entirely by attacking the stalks near the ground and causing them to decay. In such cases there seems good reason to believe that the fungous attack is not primarily above ground and due to the proximity of diseased plants, but that the fungus was present in the seed. The German investigations referred to above, show that the fungus may be present in the seed and yet not affect the germinative quality to any marked extent: it therefore becomes a matter of extreme importance to purchase seed which not only has a good record for germination, but which is known to have come from healthy

* See Centralbl. f. Bakt., Abth. II, Bd. I, pp. 620–624 and 881–886. 1895.
† Cf. Del. Agr. Exp. Sta., Bull. XLI, pp. 9–11. 1898.

plants. In one case which was brought to my notice, a "damping-off" fungus (*Pythium?*) had apparently coöperated with the *Ascochyta* in causing the decay of the stalks, for the diseased tissues near the surface of the ground were found to be crowded with resting-spores (*oospores*) apparently belonging to the genus *Pythium.* This fungus had probably attacked the seedlings very early; it had then been checked by dry weather, but meanwhile had so weakened the plants that they fell a ready victim to the *Ascochyta,* which, had it not been for the *Pythium,* might have done no more than its usual trivial damage. Should the disease threaten serious injury in future, it would be advisable to obtain seed from a distance where the disease has not been present, to select land which has not borne peas for a number of years, to secure thorough drainage, to avoid the use of manure on the surface of the soil around the base of the plants, and finally, in case it is necessary to use the same land for two or more successive crops of peas, to gather and burn every vestige of the vines as soon as the crop is harvested.

The Leaf-Spot of Alfalfa. The growing of alfalfa as a fodder-crop in this part of the country has not attained proportions sufficient to attract much notice, nevertheless we occasionally hear of some serious damage done to the crop. During the past Summer samples of alfalfa were sent in to the Station, evidently attacked by the "leaf-spot" fungus, *Pseudopeziza.* This causes small, yellowish blotches on the leaves, in the center of which are seen the minute, black, fruiting cups of the fungus. In the West the "leaf-spot" disease does immense damage to alfalfa, sometimes destroying half the entire crop. It has been admirably described in the Report for 1897 of the Iowa Agr. Exp. Sta., pp. 25-34. Fortunately the frequent cutting to which, in the ordinary course of things, alfalfa is subjected, presents a ready means of checking the spread of the fungus, since if cut and fed to cattle before the spores mature, by far the greatest source of infection is prevented. We do not know at present exactly the season at which the spores mature, but as the specimens which I received last Summer were collected about May 15th and did not at that time show any mature spores, it is safe to assume that diseased plants do not become a serious menace to their neighbors before June 1st, and may

therefore be safely cut and fed to stock up to that date. Should the disease occur later in the season the only practical means of combatting it is either by continuous cropping or by watching for its first appearance, which will generally be at not more than one or two points in the field, and immediately cutting and burning the affected plants.

Disease of Peppers. Notwithstanding the dry weather which characterized the past Summer, peppers, especially when grown upon low land, suffered severely from anthracnose (*Colletotrichum nigrum*). This disease makes its appearance on the fruit in the form of roundish blotches, which increase rapidly in size, become pale brown in color and finally give rise to numbers of minute pustules of a brown or finally black color, in which the spores are produced. Not only do these blotches disfigure the fruit, but they offer a favorable ground for the development of other organisms productive of decay. Fields were seen last Summer in which at least 25% of the fruit was rendered worthless by this fungus. No experiments looking to its prevention were attempted, but Halsted reports in the 17th Report of the N. J. Agr. Exp. Sta., p. 337, that fungicides are not efficient in this case. In a dry season Halsted secured good results from irrigation and by mulching the plants, but in seasons of normal rainfall these methods proved useless. Fortunately peppers are not a crop upon which the farmer places much dependence.

OBSERVATIONS ON THE FERTILIZATION OF PEACH ORCHARDS.

By E. H. Jenkins.

For several years the Station has carried out experiments on this subject. One of them is here described as matter of record, although of course no decisive result can be looked for until after a considerable term of years. The peach is particularly unsatisfactory as an experiment crop because the fruit, which alone furnishes a numerical expression of the effects of fertilizers, tillage or other factors of growth, cannot be expected each year and sometimes fails for a number of years.

The experiment here described is on land of Mr. A. E. Plant in Branford. The orchard is on a high hill, some miles from the shore of Long Island Sound. The soil is a gravelly loam of fairly good quality. The history of the field is as follows:

After lying several years in grass, the lot was plowed in the fall of 1894, was dressed during the winter with from 75 to 100 bushels of unleached Canada ashes per acre, and was planted to peach trees in the Spring of 1895, the varieties being Mountain Rose, Champion and Early Rivers. Twelve hundred pounds of Mapes' corn manure was applied per acre, and the orchard planted to corn..

The following winter, 1895–1896, 75 to 100 bushels of unleached ashes per acre were again put on the land.

In the Spring of 1896, there were laid off on the south end of the orchard eight plots or blocks of trees. Each of these plots covered about one-third of an acre and had 48 trees standing on it. The number of trees of the three varieties named was the same on each plot. To the northern half of each plot, 3⅓ bushels or 167 pounds of slaked oyster shell lime were applied.

The plots, beginning at the west end, were marked and fertilized as follows:

A 65 pounds of muriate of potash, 160 pounds of acid phosphate.
B " " " " " " " "
and 170 pounds of cotton seed meal.
C 65 pounds of muriate of potash, 160 pounds of acid phosphate.
D 130 " " " " " " "
E 260 " " " " " " "
F 260 " high grade sulphate of potash, 160 pounds of acid phosphate.

These fertilizers, and the lime, have been applied each Spring, since 1896, in April or very early in May.

In August of each year, crimson clover has been sown on plots C, D, E, F, and has always grown well and lived through the winter. It is plowed under in May. Plot A has abundance of potash and phosphoric acid but gets no nitrogenous fertilizer. Plot B has each year about 500 pounds of cotton seed meal per acre, containing 35 pounds of nitrogen, while all the other plots receive their nitrogenous fertilizer in form of crimson clover as a green manure.

Plots C, D, E should show the the effects of heavy dressing with muriate of potash and F should show the comparative effects of a heavy dressing of high grade sulphate.

The southwest corner of the field, on plot A, is the dampest part of the lot, in spite of an underground drain, and we believe plot A is the least favorably placed of all the plots.

Each year a certain number of the trees have died and have been replaced by new ones in the Spring. No case of yellows has been found in the whole orchard.

Each Spring a census of the trees which died during the last year, has been made, which is as follows:

NUMBER OF DEAD TREES FOUND IN THE SPRING.

	1896.	1897.	1898.	1899.	Total.
Plot A	2	12	2	1	17
B	3	6	1	1	11
C	2	3	1	1	7
D	0	1	2	0	3
E	0	1	0	0	1
F	0	0	0	0	0
	7	23	6	3	39

Plot A has suffered most, losing more than one-third of the trees on it in four years. This we believe, is partly due to the excess of water in the soil. Plot B has lost 11 trees, less than one-fourth of the whole number; C, D and E a smaller number, and on F not a single tree had died.

In 1898 there was a fine set of fruit buds, but most of the very young fruit fell later in consequence of cold storms at and just after setting time.

In 1899 there was an excellent set of fruit in the large orchard of which the trees above referred to form a part, while

in most orchards of the State, every flower bud was killed during the winter. As illustrating the vagaries of the peach crop and the New England winter, it is worth noting that in another part of Mr. Plant's orchard, more than 900 trees which blossomed fully in April soon showed signs of trouble and died before the leaves came out. They had been killed by the winter near the ground as effectually as if girdled with a knife.

The Early Rivers peaches, 95 baskets in all, were picked in our absence and no note is made of them. The other two varieties were picked and measured under the supervision of one of the Station staff. The crops were as follows:

Peach Crop. Number of Baskets.						
Plot	A	B	C	D	E	F
No. of baskets	65	117	81	110	155½	140½
No. of trees in bearing exclusive of Early Rivers	20	31	23	27	36	30
Average number of baskets per tree in bearing	3.2	3.8	3.5	4.1	4.3	4.7

Any discussion of these results at the present time would be premature.

EXPERIMENTS IN CURING AND IN FERMENTING WRAPPER-LEAF TOBACCO. SEASON OF 1899.

By E. H. Jenkins.

Curing the Crop.

These experiments are in continuation of those begun in 1897, described in the Reports of this Station for 1897, page 223, and for 1898, page 297.

The barn with the heating apparatus was described in our last report as follows:

This barn is 60 feet long, 32 feet wide, 16 feet high to the eave plates, having vertical ventilators of the usual kind, hinged just below the eaves and opening down to the sills. It also has a ventilator two feet by three in each gable end, just below the peak, with a shutter which can be closed or opened from the ground by cords. Below this ventilator there are six narrow ventilators, hinged from the top. On each end of the barn are two large doors, built in the usual way, and on one side is a small door for entering the barn during the cure. The sides and ends of the barn are battened on the inside. The lower tier of poles for hanging tobacco rests on slip-girths, so that the lath of tobacco on this tier hang crosswise of the building, like those above. The barn is built on stone and brick piers. The space between the sills and the surface of the ground is boarded up. In the center of the barn is a brick chimney—with a flue thirteen by eight inches in the clear,—which goes through the roof just to one side of the ridge pole. Except that the barn has a chimney and is made as tight as possible and battened, it is not at all unlike other barns in the neighborhood. Two stoves of heavy sheet iron, two feet eight inches from front to back, with a breadth and height of two feet four inches, each stove having a cast-iron door with draft, are used for heating the barn. One stove on each side of the barn, midway from end to end of it, is set in an excavation outside the building, the bottom of the stove being six feet below the level of the sill. Around the sides and rear end of the stove is a brick wall, having an air space of five inches closed in the front side. This wall is five inches higher than the top of the stove, iron bars are laid across it, which support a sheet-iron cover,

and this, in turn, is covered with earth. On the front, near the bottom, are openings which supply air to this air-space, which surrounds the stove except on the front and bottom.

This whole structure is three feet below the sill at its nearest point. From the stove, and through the air-space, a smoke pipe seven inches in diameter passes under the sill and into the barn straight to the chimney, having a rise of about five feet in going the distance of seventeen or eighteen feet. From the air-space, two hot-air flues, seven inches in diameter, pass into the barn, which is built with its ridge running east and west. Within the building and four feet from the south side of the barn one of these flues turns at a right angle and runs east to within four feet of the east end of the barn, thence north to within four feet of the center line of the building, and thence west till it joins the smoke pipe near the chimney. The other hot-air flue on the south side runs in a similar way to the west end of the barn and back again to the smoke pipe. The arrangement on the north side of the barn is similar. By brick supports these hot-air pipes are given a pretty uniform pitch, rising all the way from where they enter the barn to where they enter the chimney.

The hot-air flues are also connected, where they enter the building, with the smoke pipe, and by the use of dampers, all the smoke can be sent through the smoke pipe direct, but the hot air from the hot-air chamber, through the flues; or by properly adjusting the dampers, the products of combustion can be sent through the hot-air pipes also.

It is best to start the fires with direct draft to the chimney, but when the chimney has got well warmed the draft is sufficient to draw the smoke through the hot-air flues without smoking the building at all.

The pipes are numbered, and, when not in use, taken up, boards being laid down where the pipe runs below the surface of the ground and covered over with earth. After the barn is filled with the harvested tobacco the pipes can be laid in an hour's time.

In front of each stove the earth is sloped up to the general surface of the field, and boards are so placed as to prevent caving. A lean-to affords protection to the one who tends the fires. The building was inspected by the insurance companies and insured on a premium of one and one-half per cent.

In the fall of 1898 the tobacco field, containing scant two acres, was dressed with the finely cut stalks of the crop of 1899. In the winter about twenty-nine tons of New York stable manure was put on the land in large heaps, which were spread in the early spring and plowed under on April 15th.

On May 3d, 4,000 pounds of cotton seed meal, 1,000 pounds of cotton hull ashes, 1,200 pounds of swift-sure superphosphate and two barrels of lime were sown broadcast on the field and cultivated in.

On May 12th two pounds of Paris green were mixed with two hundred pounds of moist bran and scattered over the rows to destroy cut worms. The tobacco plants were set on May 18th.

The crop was cultivated in the usual way, grew without suffering from drought and was harvested on August 4th and 5th, and hung as usual on lath, which were eight inches apart on the poles. At harvest the crop was believed to be a remarkably good one, certainly the best *in appearance* of any since 1892.

The crop was cured as far as possible in the usual way, heat being used simply to continue the cure when the weather conditions were unfavorable.

In a dry, hot day the interior of the barn, when filled with green tobacco, is much cooler than the air outside. For instance, on August 6th, a hot clear day, at 4 P. M., the air outside was at 82°, while in the middle of the barn it did not go above 74°.

The next day at noon the temperature in the shade outside was 80°, inside 70°. On August 8th at noon, in the shade outside, temperature 78°, inside 65°. At all these times every door and ventilator was wide open. Obviously at such times artificial heat would be quite unnecessary and perhaps harmful. The tobacco cures of itself quite fast enough and the movement of air, at least in the center of the barn—unless disturbed by high wind—is downward; i. e. the air within is colder than that without and although more moist is still heavier and sinks down, drawing in from above the warm, dry, outer air.

At night, however, the conditions are reversed and change very quickly between five and seven o'clock. A few illustrations of what was often noted will suffice.

On August 5, a close, "hot," foggy night, with a little rain, the temperature outside, from 10 P. M. till 2 A. M., ranged from 69° to 67°. Inside the barn, which was only open under the sills and in the ridge and with a moderate fire, the temperature was 72° to 73° all night.

The next night the temperature outside and inside the barn ranged as follows:

	Outside.	Inside.
4 P. M.	82°	70°
6 "	69	69
9 "	58	68
11 "	54	66
1 A. M.	51	66
3 "	51	65
5.30 "	51	65

The fire was started at 6 P. M.

A still more striking example of the low temperatures to which curing tobacco may be subject in August, is the following:

On August 8th, after a clear cool day, when the barn stood wide open, it was closed as soon as the temperature was alike outside and inside and a fire was started.

The temperatures in the night were as follows:

		Outside.	Inside.
Aug. 8.	8 P. M.	48°	58°
	9 "	45	58
	10 "	45	59
	12 "	40	57
Aug. 9.	2 A. M.	38	55
	7 "	51	55
	12 M.	78	65

At two o'clock in the morning the air outside was only 6 degrees above the freezing-point of water.

In all cases the inside thermometer hung in the second tier from the ground and not over any hot-air flue.

It is clear that at night the air within the barn is much warmer than outside, and if it is only open under the sill and in the ridge the current will be in the direction opposite from that in the day time, i. e. upwards; the warmer, and therefore

lighter air inside being pressed up by the colder, heavier air without.*

These observations led us to follow the plan of opening the barn wide on clear, dry days and airing it thoroughly. As soon as the outside temperature fell to that of the inside, the barn was closed, except under the sills and in the ridge, and the fires were started and run through the night. The object was to assist the upward air current which naturally moves at night and to keep the tobacco from the night chill, thus making the temperature of curing much more nearly uniform.

The cure was started on August 5th, and on August 14th was well advanced, much further than in the case of tobacco cut at the same time, but curing under the usual conditions. Even the top leaves were turning yellow.

It was judged that as long as the weather was good no further heating was desirable, as it might dry the leaf too quickly. It was necessary for the writer to leave the experiment at this time and the barn stood open, night and day, till August 26th.

The leaves, excepting the mid-ribs, were nearly cured on that date. The tobacco was very damp, as the weather for a whole week past had been warm, damp and "muggy," with one very heavy rain:—typical "pole-burn weather."

The barn was closed, the fires started, and the whole crop was dried out without damage. Pleasant weather followed and on September 21st and 22d, the crop was taken down and stripped.

It is clear to us that this method of curing is a valuable help in preventing pole-burn. We are not yet prepared to recommend this special form of heating apparatus, and we find that while by it the bottom tier is absolutely protected from pole-burn there seems to be an eddy or place where there is dead air in the second or third tier which may give trouble. It is planned to experiment further on the subject.

* Repeated observations made at night, while the fires were running, showed that the air five feet above the ground within the barn,—away from the flues,—was warmer, had lower relative humidity but a larger absolute humidity than the air outside. It must, therefore, be specifically lighter.

The Fermentation of the Tobacco Crop.

During the spring and summer of 1899, some observations were made on the temperature of tobacco which is fermented in cases by the method commonly practiced in Connecticut.

This method consists in tightly packing the sorted tobacco, tied in hands, into cases holding 300 pounds or more, which are piled up in unheated storehouses, turned once or twice and are sampled and sold after lying through one summer. The packing is done in the first three or four months of the year.

The thermometer readings were made by the firm of L. B. Haas & Co. of Hartford, who also kindly offered the use of four cases of wrapper-leaf tobacco for these observations. The telephone thermometers were loaned to us by Prof. Milton Whitney of the United States Department of Agriculture.

Readings were taken almost daily for several months, but a single weekly reading will show the changes of temperature sufficiently.

The four cases represent different grades of wrapper-leaf stored in different rooms of the packing house.

The temperatures in the center of each case were as follows:

No. of Case.	2010	4	2393	329
Mar. 4	57°	65°	58°	—°
11	59	68	60	60
18	61	77	62	61
25	61	77	68	60
Apl. 1	63	76	74	
8	63	76	73	
15	63	78	73	
22	64	79	74	79
29	69	80	75	81
May 6	75	85	79	83
13	78	86	79	84
20	77	85	76	82
June 3	79	80	79	80
24	84	81	83	82
July 1	82	79	83	81
15	—	81	—	82
29	83	82	82	83
Aug. 5	—	—	83	

It will be seen that case No. 2010 lay for nine weeks, tightly packed before the tobacco reached even "temperate" heat, 70° F. Possibly the time was still longer, for we have not the date on which the leaf was packed.

We certainly know that some cases of the 1898 crop damaged *in the case,* between the time of packing and the first of May, and we believe that the greatest danger to cased tobacco from mold and mustiness is when it lies cold and damp, unfermented, waiting for sufficient heat from the air to penetrate it and start the fermentation. During the last two years a "forced sweat" has been used by some dealers in order to get tobacco as soon as possible on to a waiting market. For this process the leaf is cased as above described and put into a room where the temperature is maintained for about six weeks at 100° to 130° and the air is kept somewhat moist. The tobacco comes out "sweated," with its gum gone and keeping its light colors. It is fairly satisfactory, quite even in color and has found a ready market. But opinions differ considerably as to its real value as compared with "natural sweat" leaf. In Sumatra, Cuba, Germany and Holland as well as in Florida, a third method of fermenting wrapper-leaf is universally employed for which there is no precise name. It is not a "forced" fermentation, for in the fermenting room the temperature is not raised above 80°–85° F. It is a "natural" fermentation, but the leaf is put at once into a summer climate instead of lying for several months in the cold, waiting for the turn of the seasons. It differs also from the other two methods in that the leaf is piled loosely in large heaps or bulks containing thousands of pounds for the fermentation, instead of being packed tightly in cases containing a few hundred pounds each. This method was discussed in our Report for 1898, page 302, where is also described an experiment in fermenting Connecticut leaf by this means, the first experiment of the kind, we believe, on record. This year the same experiment has been repeated with more skillful supervision and has demonstrated the unqualified success of the method.

Professor Milton Whitney of the Division of Soils of the United States Department of Agriculture, most kindly coöperated with us and secured for us the services of Mr. M. L. Floyd, the tobacco expert of the Department, who has had years of practical experience in handling, fermenting and selling cigar leaf tobacco in Florida and other States. To these gentlemen is largely due the success of the undertaking. Mention should also be made of the Connecticut Tobacco Experiment Co., an

organization of practical tobacco growers, which has for eight years coöperated with this Station in experimenting on the fertilizing, curing and fermenting of leaf tobacco.

The sorted tobacco cured as described on previous pages, was sent from Poquonock to the Station and on December 16th was weighed in as follows:

No. 1.	Long wrappers	1,289½	pounds.
" 2.	Short wrappers	547	"
" 3.	Long seconds	375	"
" 4.	Fillers	157½	"
" 5.	Dark wrappers	449½	"
" 6.	Top leaves	257½	"
	Total	3,076	"

The fermenting room, in the laboratory cellar, was kept at a temperature of 80°–85° by a steam pipe passing through it to the greenhouses beyond and the air could be dampened by blowing steam from a pet-cock in this pipe.

Mr. Floyd took charge of the whole operation. On December 14th about 1,900 pounds of trash tobacco, the sorting-room waste, was shaken out and sprayed with warm water till it was wet and "soggy," and put into the fermenting room in a loose conical pile, covered with blankets. The next day it was shaken over and piled as before.

It was no longer soggy, no water stain was visible; it was soft, pliable and elastic and contained 33.8 per cent. of moisture.

A thermometer in the center of this pile showed the following readings:

Dec. 15.		95°
" 16.	A. M.	114°
" 16.	M.	117°
" 16.	P. M.	117°
" 17.	A. M.	128°
" 18.	"	131°

Temperature of the room, 80°–84°

A platform 12 feet long and 5 feet wide was laid on joists which raised it four inches from the floor, with vertical headers of boards at each end. On this platform was packed a layer of the hot trash eight inches deep, and next above a layer of first wrappers, butts on the outside, tips always towards the center. A second layer was put on, the butts resting on the body of the

leaf below, and about a foot from the outside, overlapping, as shingles are laid. Then followed a thin layer of trash, then first wrappers as before and so on as long as the trash lasted. Then the remaining first wrappers were put on in layers without trash. No pressure was applied; the workmen stood on the floor and simply laid the hands of tobacco on the bulk loosely.

The trash was mixed in this way to increase the heat and moisture; for being a first experiment it was not thought wise to dip the wrappers. Experience showed, however, that water could have been safely used and the layers of trash omitted. The bulk was covered with blankets. The same day the No. 2 wrappers, which were too dry to ferment, were brought into "case" by dipping the butts about two inches deep into warm water, and then holding the hands by their butts and shaking them vigorously till the water was well distributed.

They were then loosely piled in the fermenting room to "draw."

The next day they were put on the bulk in the way above described, but without any trash tobacco.

All the other grades were brought into case in the same way and put in the bulk, which was in the end eight or nine feet high and must have weighed at least 5,500 pounds. The whole was covered with trash, woollen blankets and rubber blankets on the outside.

The air in the room was kept just moist enough so that a hand of unfermented tobacco hung in the room would remain pliable.

As the bulk was built, telephone thermometers were built in with it which could be easily read without removing them.

The records of this bulk are as follows:

		No. 1. Near bottom of bulk.	No. 2. A foot below No. 3.	No. 3. Near top of the No. 1 wrappers.	No. 4. Near top of bulk.
Dec. 18.	P. M.	88°	84°	73°	—°
" 19.	A. M.	97	88	80	87
	P. M.	99	90	85	89
" 20.	A. M.	107	98	93	97
	P. M.	110	103	99	101
" 21.	A. M.	113	111	108	107
	P. M.	113	114	113	111
" 22.	A. M.	114	118	119	115
	P. M.	115	120	121	115

The heat rose somewhat slowly at the bottom of the heap. In other parts the temperature rose during the four days at the rate of from eight to twelve degrees in twenty-four hours.

As the event proved, the tobacco might have been left undisturbed for several days longer, but wishing to see how the fermentation was going, the bulk was taken down on December 22d, and rebuilt after shaking out the leaf slightly. This was finished in the afternoon of December 23d. As far as possible, the outside tobacco from the first bulk was put inside the second and what was at the top of the first bulk was laid at the bottom of the second. The readings of the thermometers inside the bulk were as follows:

	No. 1. Near bottom, west side.	No. 2. In middle, west side.	No. 3. Near top, west side.	No. 4. Below center, east side.	No. 5. Near top, east side.
Dec. 23. P. M.	83°	86°	92°	84°	85°
" 24. "	93	92	96	89	93
" 25. "	93	97	104	96	104
" 26. "	95	104	112	104	112
" 28. "	100	112	115	116	114
" 29. "	103	115	115	118	115
" 30. "	107	115	115	118	115
" 31. "	108	115	111	117	114
Jan. 1. "	110	114	111	117	113

It is seen that the rise of temperature in the second bulk is much more gradual, only two or three degrees per day, and is not as large by some five degrees.

On the second of January, 1900, the bulk was turned once more in the same way as before and the thermometers replaced.

The record of this bulk is as follows:

	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.
Jan. 3	89°	94°	92°	88°	88°
4	89	96	95	92	89
5	90	99	98	97	102
6	91	101	99	105	99
7	90	104	101	107	105
8	90	105	103	108	110
9	90	108	105	108	112
10	89	107	105	105	113
11	87	107	106	105	113
13	84	105	106	105	112
14	84	105	106	104	110
15	83	104	105	104	109
16	81	104	104	102	106
18	80	103	104	102	108
23	77	100	103	101	104

It was clear that active fermentation had ceased and the leaf had begun to cool off. Examination of leaves from different parts of the pile showed that the gum was gone and the whole body of leaf was thoroughly fermented or "sweated."

It was, however, allowed to stand in the bulk for some time longer. It was then examined by members of two large New York firms who deal in domestic leaf, a Connecticut tobacco dealer and a cigar manufacturer who handles large quantities of Connecticut wrapper leaf.

The unanimous opinion of all these gentlemen was that the process was a remarkably successful one. The leaf was of a perfectly even color from the tip to the stem end.

The gum was all gone, the leaf was light and elastic and there had not been the slightest damage during the fermentation. Particular attention was given to the leaves on which the butts of the next layer of leaves rested, as the dealers thought that there some damage must have been done. Careful search was made, but not a single damaged leaf could be found in the bulk. Another point was that of water-stain. As stated above, all the hands—except those of first wrappers—had their butts dipped in warm water and the leaves shaken out, immediately before putting into the fermenting room.

A few of the second wrappers came out of the fermentation with some water-stain near the mid-rib of the leaf, but none on the margin, but the most of the dipped leaves showed no traces of water-stain. The second wrappers were dipped just at nightfall and in great haste and probably not sufficient care was taken in shaking them out. If they had been left a few days longer in the first bulk, probably there would have been no water-stain, even in the over-wet leaves.

Our experience has shown that unfermented leaf will bear a good deal of wetting *if it is warm and goes at once into active fermentation.* But under no other circumstances will it bear wetting.

After being examined by these experts the crop was cased and after standing in the cases for two weeks at about 70° F. was shipped to be sold.

It is interesting to compare the weights of the fermented and unfermented leaf.

		Before casing and fermenting.	After fermenting.
No. 1.	Long wrappers	1,289½	1,209½
" 2.	Short "	547	599½
" 3.	Long seconds	375	371
" 4.	Fillers	157½	173
" 5.	Dark wrappers	449½	462
" 6.	Top leaves	257½	253
	Total	3,076	3,068

The whole crop weighed only eight pounds less after fermenting than before, and three of the grades were damper at the end of the process than before they were dampened at the beginning of it. Of course the fermented leaf will dry out rapidly in the cases. Thus between February 7 and February 23, the loss of moisture from the whole casing was 247 pounds.

THE AREA OF LEAF SURFACE ON THE TOPPED TOBACCO PLANT.

By E. H. Jenkins.

To get an approximate idea of the amount of leaf surface on a tobacco plant or on an acre of tobacco, a single plant which had been topped and suckered and was ready for harvest was stripped of its leaves, eighteen in number. The outline of each leaf was carefully traced in pencil on a rectangular sheet of paper, and the figure of each leaf thus traced was cut out with scissors.

The area and weight of the sheets used for this purpose had been carefully determined beforehand. By weighing the leaf figures and the cuttings separately it was easy to calculate the area of these leaf figures, assuming that the paper is of uniform weight for each unit of surface. The eighteen leaves were thus calculated to have an area of 27.2 square feet.

Reckoning 7,700 plants to the acre, it would appear that the leaves from one acre of Connecticut Havana tobacco, at harvest time, would cover $4\,^{8}/_{10}$ acres.

TESTS OF THE VITALITY OF VEGETABLE SEEDS.

By E. H. Jenkins.

Since November, 1898, two hundred and ninety-one samples of seeds, chiefly of garden vegetables, have been tested as to their vitality. This work has been done in the interest of seedsmen and of purchasers, and has been executed for the most part by Mr. Churchill.

The methods of testing adopted by the Association of American Agricultural Colleges and Experiment Stations have been closely followed, and the standard germinating chambers have been used.

Table I presents the average, maximum and minimum vitality of all the seeds tested at the Station by the newly adopted methods. The age of the seeds given in the table is that reported by the seedsmen or growers who sent the samples. The samples were in all cases drawn by the persons sending them. Since the samples were sent by the seedsmen for their own information, and it was understood that the results of the tests were not to be published as representing the character of their goods, there was no motive for any misrepresentation as to the age of the seed. The samples for the most part undoubtedly represented cleaned seed as prepared for market.

Table I.—Germination Tests of Vegetable Seeds.

	Age of Seed in years, when tested.	Number of Samples.	Average percentage by number of seed sprouting.	Maximum.	Minimum.
Beans	0–1	7	86.5	100.0	56.7
	1–2	15	91.1	100.0	72.0
	2–3	8	87.0	100.0	59.0
	3–4	15	92.3	99.0	83.0
Beets	0–1	21	154.4	211.0	65.5
	1–2	16	162.8	230.0	75.0
	2–3	7	140.8	192.0	73.5
Brussels Sprouts	3–4	2	18.4	36.0	0.8
Cabbage	0–1	30	83.3	95.8	44.0
	1–2	22	73.5	96.5	28.3
	2–3	3	71.5	88.0	43.0
	3–4	4	62.8	91.5	27.0
	4–5	2	64.9	85.8	44.0
	6–7	1	63.8	---	----
Carrots	0–1	21	57.6	90.8	35.0
	1–2	23	44.1	91.3	14.5
	2–3	5	43.6	54.2	31.0
Cauliflower	0–1	1	84.5	----	----
	1–2	6	51.2	88.3	27.5
	3–4	1	77.3	----	----
Celery	0–1	17	68.0	83.5	38.3
	1–2	15	34.7	63.8	4.0
	2–3	9	55.5	79.3	9.8
	3–4	5	55.4	63.5	27.3
Corn, Sweet	0–1	3	83.4	99.0	32.9
	1–2	13	74.5	98.0	37.5
Cress	0–1	3	61.5	91.3	35.5
	1–2	1	69.8	----	----
Cucumbers	0–1	10	86.3	99.0	57.0
	1–2	15	80.0	98.5	39.5
	2–3	2	81.2	83.0	79.5
	3–4	5	71.3	90.0	51.0
	4–5	1	79.0	----	----
Dandelion	0–1	1	70.3	----	----
Egg Plant	0–1	2	48.5	57.0	40.0
Endive	1–2	2	43.2	52.5	34.0
Kale	0–1	2	87.3	94.0	80.5
	3–4	1	45.8	----	----
Kohl Rabi	---	2	90.1	93.5	86.8
Leek	0–1	5	81.3	86.0	76.3
	1–2	3	76.5	79.3	74.0
	2–3	1	35.5	----	----
Lettuce	0–1	27	87.6	100.0	18.0
	1–2	32	80.3	100.0	23.5
	2–3	12	75.8	98.8	23.8
	3–4	1	6.4	----	----
	5–6	1	10.3	----	----

TABLE I.—*Continued.*

	Age of Seed in years, when tested.	Number of Samples.	Average percentage by number of seed sprouting.	Maximum.	Minimum.
Mangel Wurzel	0–1	2	190.0	203.0	177.0
	1–2	8	89.4	176.0	20.0
	2–3	4	103.5	181.0	21.0
Musk Melon	0–1	8	75.4	100.0	28.0
	1–2	10	70.8	96.5	29.0
	2–3	1	92.5	----	----
	3–4	5	42.8	81.0	10.5
Onion, Connecticut grown	0–1	155	72.4	97.5	36.8
	1–2	31	55.5	91.5	0.8
	2–3	20	18.1	68.3	0.5
	3–4	1	59.5	----	----
California grown	0–1	33	91.3	97.5	77.3
	1–2	9	86.5	98.0	58.5
	2–3	3	85.9	91.5	87.5
	3–4	1	10.0	----	----
Parsley	0–1	1	73.3	----	----
	1–2	6	33.4	72.0	7.8
Parsnip	0–1	5	49.9	63.5	34.3
	1–2	4	15.6	42.8	2.5
	2–3	1	30.3	----	----
Peas	3–4	2	98.5	99.0	98.0
Pepper	0–1	5	77.1	89.5	61.0
	1–2	6	48.6	70.5	16.8
Pumpkin	0–1	6	74.0	95.0	40.0
	1–2	4	48.8	91.5	1.1
	2–3	1	97.3	----	----
Radish	0–1	18	87.7	99.8	72.0
	1–2	21	69.7	98.8	31.0
	2–3	17	30.8	69.3	1.8
	3–4	11	30.0	69.5	5.3
Salsify	0–1	1	80.5	----	----
Spinach	0–1	12	84.9	89.7	59.5
	1–2	1	72.0	----	----
Squash	0–1	12	87.4	100.0	68.8
	1–2	5	93.0	98.0	75.0
	3–4	8	35.9	82.0	0.5
Tomato	0–1	14	84.8	97.0	76.0
	1–2	7	82.2	93.5	55.3
	2–3	1	65.5	----	----
	3–4	3	70.2	96.2	43.5
Turnips	0–1	6	94.9	98.8	88.8
	1–2	6	85.9	97.8	40.3
	3–4	5	79.2	94.5	49.8
Water Melon	0–1	7	82.7	100.0	56.3
	1–2	11	44.9	77.0	0.0
	2–3	7	41.7	81.0	0.0
	3–4	1	42.0	----	----
	5–6	1	69.5	----	----

The "percentage" of beet seed and mangel wurzel sprouting, as given in the table, is nearer 200 than 100. To test the vitality of beet seed, one hundred "seeds" are put in the germinating apparatus and all the sprouts are counted. As each beet "seed" is a fruit which may contain from two to six separate seeds, it is evident that the possible number of sprouts may be 600. To count the actual number of seeds in the one hundred fruits examined, which would make a true percentage statement of sprouting power possible, would be extremely laborious; but the form of statement here followed is sufficiently intelligible and is justified by usage.

Vitality of Onion Seed as affected by the Age of the Seed.

Since November 1, 1896, the Station has examined 214 samples of onion seed of the crops of 1896, 1897, 1898, and 1899. To these, in the following table, are added the results of tests made in previous years, by the methods recommended by the Association of Agricultural Colleges and Experiment Stations. In the samples examined, the percentage by number of seed which sprouted was as follows:

TABLE II.—VITALITY OF ONION SEED.

	CONNECTICUT GROWN.		CALIFORNIA GROWN.	
	No. of Samples.	Per cent. Sprouted.	No. of Samples.	Per cent. Sprouted.
Seed stated to be less than 1 year old	214	77.4	46	90.5
Seed stated to be between 1 and 2 years old	36	59.8	13	82.7
Seed stated to be between 2 and 3 years old	20	18.1	10	79.9
Seed stated to be between 3 and 4 years old	1	59.5	1	10.0

While the number of samples examined of California-grown seed is not large enough to make a close comparison, it is quite evident that a larger percentage of the California seed germinates than of the Connecticut seed.

Table II also shows that onion seed more than one year old, as a rule, has much less sprouting capacity than new seed, although in Table V are numerous cases of onion seed more

than a year old which sprout as well as most new seed. Whether the plants produced from old seed are as vigorous and productive as those from fresh seed is quite another question, on which laboratory germination tests can give no light.

Comparison of the Vitality of Crops of Connecticut-grown Onion Seed in the years 1894–1899.

The average sprouting capacity of Connecticut-grown onion seed, as determined for a number of years at this Station, has been as follows:

TABLE III.—VITALITY OF CROPS OF ONION SEED.

	No. of Samples Tested.	Average Percentage Sprouted.
In 1880	14	87.0
1894	25	82.9
1895	13	85.5
1896	44	72.4
1897	39	77.9
1898	68	69.3
1899	62	89.0

The sprouting capacity of onion seed in 1898 was unusually low, for reasons which are not evident, while the sprouting capacity of seed of the 1899 crop has been higher than in any previous year of which we have record.

The Sprouting Capacity of Different Varieties.

The average sprouting capacity of four varieties, of which a considerable number of samples has been tested, is as follows (only those samples are here included which were alleged to be less than one year old at the time of testing):

TABLE IV.—SPROUTING CAPACITY OF DIFFERENT VARIETIES OF ONION SEED.

Variety.	No. of Samples Tested.	Average Percentage of Sprouting Seed.
Yellow Globe	97	76.8
Red Globe	87	80.5
White Globe	39	80.0
White Portugal	23	68.6
Wethersfield Red	4	71.3

The three globe varieties are essentially alike in sprouting capacity, but the White Portugal appears to be distinctly inferior to them in this regard.

TABLE V.—GERMINATION TESTS MADE IN 1899 OF ONION SEED RAISED IN CONNECTICUT.

Variety.	Station No.	Age of seed in years at time of testing.	Percentage of Seeds by Number.			Number of days within which one-half of the sprouting seed germinated.
			Sprouted in 14 days.	Remained hard.	Decayed.	
Yellow Globe, Crop of 1899--	2006	0–1	92.5	1.8	----	3
	2010	0–1	92.3	2.8	----	4
	2011	0–1	86.8	2.0	----	4
	2012	0–1	79.5	3.8	----	3
	2013	0–1	90.0	3.8	----	3
	2014	0–1	92.5	2.8	----	4
	2015	0–1	92.5	3.2	----	3
	2016	0–1	90.3	2.0	----	3
	2029	0–1	84.0	4.8	----	4
	2030	0–1	83.5	5.5	----	3
	2032	0–1	83.8	5.8	----	3
	2040	0–1	92.8	3.8	----	3
	2053	0–1	90.0	2.2	----	4
	2061	0–1	91.3	4.8	----	3
	2062	0–1	87.8	4.8	----	3
	2078	0–1	85.0	3.0	----	4
	2079	0–1	95.3	0.8	----	3
	2254	0–1	81.0	2.0	----	3
	2257	0–1	82.0	2.0	----	3
	2258	0–1	84.3	1.5	----	3
Crop of 1898--	2259	1–2	25.8	18.3	----	4
Red Globe, Crop of 1899-----	2007	0–1	89.0	2.8	----	3
	2017	0–1	95.5	0.2	----	3
	2018	0–1	97.0	1.0	----	4
	2019	0–1	88.8	1.5	----	3
	2020	0–1	91.3	1.8	----	3
	2026	0–1	94.3	2.0	----	3
	2036	0–1	88.0	0.5	----	3
	2039	0–1	93.5	2.5	----	3
	2049	0–1	88.5	1.2	----	4
	2050	0–1	91.8	1.8	----	3
	2051	0–1	90.3	3.2	----	3
	2052	0–1	89.8	2.0	----	3
	2054	0–1	88.5	2.5	----	4
	2055	0–1	89.3	3.0	----	3
	2059	0–1	88.8	3.8	----	3

TABLE V—CONTINUED.

Variety.	Station No.	Age of seed in years at time of testing.	Percentage of Seeds by Number.			Number of days within which one-half of the sprouting seed germinated.
			Sprouted in 14 days.	Remained hard.	Decayed.	
Red Globe, Crop of 1899	2063	0–1	88.8	2.2	----	3
	2080	0–1	93.0	1.8	----	3
	2248	0–1	93.3	1.8	----	?
	2249	0–1	95.5	1.0	----	?
	2250	0–1	86.8	4.0	----	?
	2251	0–1	84.8	6.2	----	?
	2252	0–1	96.8	0.5	----	?
	2255	0–1	94.3	1.8	----	3
	2256	0–1	94.8	1.8	----	3
	2260	0–1	57.0	15.2	----	4
Crop of 1898	2048	1–2	56.8	18.0	----	5
	2284	1–2	0.0	34.5	----	0
White Globe, Crop of 1899	2008	0–1	97.5	1.5	----	3
	2021	0–1	97.0	1.2	----	3
	2022	0–1	90.8	3.2	----	4
	2023	0–1	95.3	0.8	----	4
	2024	0–1	92.8	1.0	----	4
	2027	0–1	89.5	0.8	----	3
	2041	0–1	94.8	2.8	----	3
	2056	0–1	92.5	1.0	----	3
	2057	0–1	93.8	2.0	----	3
	2000	0–1	85.8	3.2	----	3
	2077	0–1	91.8	2.0	----	3
	2246	0–1	95.5	0.5	----	?
	2247	0–1	85.8	1.2	----	?
	2253	0–1	94.8	1.5	----	?
Wethersfield Red, Crop of 1899	2072	0–1	66.0	3.5	----	3
	2287	0–1	74.5	4.0	----	3
Crop of 1898	2004	1–2	64.0	12.6	----	4
White Portugal, Crop of 1899	2025	0–1	76.0	5.5	----	4
Crop of 1898	2038	1–2	82.8	3.0	----	4

THE NUCLEIC ACID OF THE EMBRYO OF WHEAT AND ITS PROTEIN COMPOUNDS.

By Thomas B. Osborne and George F. Campbell.

Frankfurt (Versuchs-Stationen, 47, 449) has estimated the proportion of various constituents of the embryo of wheat and found globulin, 21.62 p. c. and albumose 13.62 p. c.

O'Brien (Annals of Botany IX, 543) states that the proteids of wheat germs consist of globulins of the myosin-type, coagulating at 55°, soluble in dilute solutions of sodium chloride or magnesium sulphate and precipitated by excess of these salts; globulins of the vitellin-type, coagulating at 75°-78° and soluble in dilute solution of sodium chloride, but not precipitated by an excess; proteose; and albumin not coagulating below 80°, soluble in sodium chloride solution, not precipitated by an excess, nor by dialysis, nor by carbonic acid.

As neither of these investigators has given more than a superficial account of the protein* substances found by him in the embryo of wheat, we determined to investigate this subject, in order to learn definitely which of the proteins contained in the wheat kernel are predominant in the embryo, and whether there is any special difference in character between the proteins of the more physiologically active germ and those of the dormant endosperm.

As a result of this investigation we have found that, of the proteids described by one of us† as constituents of the wheat kernel, the albumin (leucosin), the globulin and the proteose, which in the whole seed are present in small proportions, together constitute a large part of the embryo, and further, that gliadin and glutenin, the principal proteid constituents of the endosperm, are not present in the embryo.

Although the globulin and leucosin obtained from the whole seed were free from phosphorus, all of our preparations

* In this paper the term protein denotes the basic molecules which, combined with simple acids, form the "simple proteids," and combined with other more complex groups, form the "compound proteids" (Hammarsten, Text-book of Physiology, translated by Mandel. Third Edition, 1900). The term proteid in this paper includes both of these groups of protein compounds.

† Osborne & Voorhees, Am. Chem. Jour., XV, 1893, 392.

of the globulin, and many of those of the albumin, from the embryo contained various yet considerable quantities of this element, and when digested with pepsin, yielded insoluble products having the characteristics of nuclein. The elementary composition of those preparations of the embryo-albumin which contained no phosphorus, or only traces, was the same as that of leucosin prepared from the whole seed, while the composition of those embryo-albumin preparations which contained phosphorus differed from that of leucosin in proportion to the phosphorus present.

Analyses of different preparations of embryo-globulin showed no agreement, even when corrected for ash.

These facts led us to examine our extracts for nucleic acid, and having found this acid and determined its composition, it was seen that the differences just alluded to disappear if we assume the phosphorus to be present as nucleic acid and calculate the analyses free from this acid and from ash.

In a paper recently published by one of us on "Some Definite Compounds of Protein Bodies" (Jour. Am. Chem. Soc., XXI, 486), it was shown that many, if not most preparations of so-called native proteids are, in fact, compounds of protein bodies with acids, and it was suggested that nucleoalbumins might prove to be similar phosphoric acid compounds.

In that paper it was also shown that the crystallized globulin, edestin, obtained from hemp-seed, forms a compound with one, and another compound with two molecules of hydrochloric acid, both of which are crystalline, and that the preparations of this globulin as commonly obtained, are mixtures of these in various proportions. It was also shown that the protein molecule can combine with more than two molecules of acid, so that several multiple compounds of one acid with the same protein molecule can undoubtedly exist.

That our preparations from the wheat-embryo are mixtures of two or more compounds is shown by the variable proportions of phosphorus which they contain. That phosphorus is a chief factor in determining the proportion of nuclein that separates during pepsin digestion is shown by the fact that the amount of nuclein found is always in close relation to the amount of phosphorus contained in the preparation.

That the preparations are not mixtures of already formed nuclein with ordinary proteid matter is shown by the difference in solubility and behavior of the original preparation from that of the nuclein derived from it.

It would seem, then, that the nuclein obtained by pepsin digestion is not an original constituent of the extract nor of the cells of the embryo, but results through combination of several molecules of nucleic acid with one of protein.

Accordingly we conclude that these phosphorus-containing preparations from the wheat embryo are mixtures of different protein nucleates and that when subjected to pepsin digestion, in consequence of the conversion of a part of the protein substance into proteose, the proportion of nucleic acid to unaltered protein is increased, so that higher acid nucleates are formed which are insoluble in the digestive fluid.

The grounds for these conclusions are given in the following detailed account of our investigation.

The material at our command consisted of a quantity of wheat germs, a specially prepared product of the Pillsbury Mills, from which the bran and endosperm had been very thoroughly removed, which was kindly procured for us by Mr. David Chidlow of Chicago.

The germ meal, which was prepared and sent to us in cold weather, was immediately extracted with petroleum naphtha and ground to a flour.

I. The Nucleic Acid of the Wheat Embryo.

We shall later show that the precipitate produced by saturating the slightly acid aqueous extract of this wheat embryo meal with sodium chloride contains almost all the phosphorus of the extract. We accordingly extracted a large quantity of the meal with water, saturated the extract with sodium chloride and subjected the precipitate to a vigorous pepsin digestion. We thus obtained a considerable quantity of nuclein from which we prepared nucleic acid in the following manner:

The nuclein was thoroughly washed with water and then dilute potash solution was added until all the nuclein had dissolved and its solution become faintly alkaline to phenolphthalein.

This solution was cautiously treated with dilute hydrochloric acid until a precipitate was formed, which separated readily from the solution. This was filtered out and the clear filtrate found to yield no precipitate on adding a *little* more acid. A considerable quantity of strong hydrochloric acid was then added, causing a precipitate of nucleic acid, which separated in large flocks that rapidly settled to a coherent layer. The deposit continued to contract and soon became so dense and brittle that it could be ground to a powder even under water. The solution was decanted, the sediment was thoroughly washed, redissolved with alkali and again thrown down by adding acid. Since this last precipitate still contained much coloring matter, it was again dissolved with alkali and the solution poured into alcohol. This retained the basic coloring matter and threw down a voluminous precipitate of potassium nucleate, which was thoroughly washed with large quantities of alcohol, dried to remove the alcohol and then dissolved in water and the nucleic acid reprecipitated by an excess of hydrochloric acid. Since all the coloring matter had not been removed by the preceding treatment, the precipitate was twice dissolved in alkali and precipitated by pouring into a large volume of alcohol. The nucleic acid was then thrown down by gradually adding dilute hydrochloric acid to the solution of the potash salt; after thoroughly washing the precipitated acid with water and with alcohol it was dried over sulphuric acid and found to weigh 10.14 grams.

After drying to constant weight in hydrogen at 100°, its weight remained unchanged on further heating at 110° in air. When thus dried it had the following composition:

	I.	II.
Carbon	36.18	36.31
Hydrogen	4.48	4.42
Nitrogen	16.03	16.10
Phosphorus	8.95	8.86
Ash	3.52	
P_2O_5 in ash	2.88	
Difference	0.64	

The ash consisted, chiefly if not wholly, of potassium metaphosphate and therefore by subtracting from it the P_2O_5 which it contained,we obtain the amount of inorganic base which

had been precipitated as an acid salt together with the free nucleic acid. Calculating our analyses free from this base, we have the following figures:

COMPOSITION OF NUCLEIC ACID.

	Found.	Calculated for $C_{21}H_{31}N_8P_2O_{15}$.
Carbon	36.48	36.16
Hydrogen	4.48	4.45
Nitrogen	16.17	16.01
Phosphorus	8.96	8.89
Oxygen	33.91	34.49
	100.00	100.00

About 2 grams of this preparation were hydrolyzed by heating for an hour and a half in a boiling water bath with 2 p. c. hydrochloric acid.

On adding ammonia to this solution, a precipitate soon separated which was digested on the water bath with an excess of ammonia, filtered out, washed, dried over sulphuric acid and found to weigh 0.27 gram.

This substance gave the murexide reaction and was insoluble in hot ammonia, both of which properties are characteristic of guanin. On analysis this crude guanin was found to contain:

	Found.	Calculated for guanin $C_5H_5N_5O$.
Carbon	40.96	39.74
Hydrogen	3.67	3.31
Nitrogen	45.21	46.36
Oxygen	10.16	10.59
	100.00	100.00

The solution filtered from the guanin was precipitated by cold ammoniacal silver nitrate and the voluminous, gelatinous precipitate washed, pressed on filter paper, suspended in water and decomposed by hydrochloric acid. The solution, containing the hydrochloride of another base, was repeatedly evaporated with water to decompose the chloride and the free base found to weigh 0.2272 gram. This was again dissolved in water and the silver salt precipitated from a boiling solution, the silver compound was decomposed with hydrochloric acid and the solution of the hydrochloride was evaporated and crystallized.

The substance separated wholly in four-sided prisms, most of which were truncated by planes at right angles.

This hydrochloride was then converted into the picrate by dissolving in water, adding a little ammonia, evaporating to dryness, dissolving in about 100 cc. of water and precipitating with a 1.1 p. c. solution of picric acid added cautiously. The very voluminous yellow precipitate was quickly filtered out with the help of a pump, washed thoroughly with water and dried over sulphuric acid. We thus obtained 0.3766 gram of a picrate, which lost nothing on drying at 110° and had the following composition:

	Found.	Calculated for Adenin Picrate, $C_{11}H_8N_8O_7$.
Carbon	36.07	36.27
Hydrogen	2.51	2.19
Nitrogen	30.28	30.77
Oxygen	31.14	30.77
	100.00	100.00

From the behavior of this base and the composition of its picrate, it is evidently adenin. Since this acid yields on hydrolysis the purin bases, guanin and adenin, as well as phosphoric acid, there can be no doubt that it is a true nucleic acid closely related to the guanylic acid recently described by Bang (Zeit. f. physiol. Chem. XXVI, 133). The facts that we obtained these two bases from the nucleic acid in nearly molecular proportion and that almost all the nitrogen of the acid was recovered in the guanin and adenin separated from it, lead us to believe that both these bases exist together in the acid molecule. If such is the case, our formula already given must be multiplied by 2.5, making it, $C_{53}H_{77}N_{20}P_5O_{37}$. This formula resembles that of guanylic acid, which calculated to the same basis, is $C_{55}H_{75}N_{25}P_5O_{42}$. The two acids are different, since Bang's guanylic acid yields a pentose on hydrolysis, whereas we have obtained no evidence that any sugar can be derived from our acid. As we are at present engaged in a study of the reactions and constitution of this acid, we will reserve further statements respecting it for a future paper, which we expect to be able to publish soon.

II. The Proteids of the Wheat Embryo.

The Aqueous Extract.

The germ flour, described on page 307, when treated with water, yields a gummy mass from which a clear extract is secured with difficulty. From 500 grams of meal an extract was obtained with 2,000 cc. of water, of which 1,400 cc. could be filtered clear. This extract was neutral to litmus, alkaline to lacmoid, and so acid to phenolphthalein that 19 cc. of decinormal alkali were required to neutralize 100 cc. of it to this indicator.

When a freshly prepared, dilute, aqueous extract of the recently ground wheat germs is heated in a water bath, no coagulation occurs, the solution becoming slightly opalescent. If a more concentrated extract, such as may be obtained by treating one part of meal with 5 parts of water, is thus heated, the entire solution solidifies to a firm, opaque jelly, free from visible particles. If, to either of these solutions a very little hydrochloric acid is added before heating, an abundant flocculent coagulum separates on heating.

After standing awhile, the aqueous extract becomes gradually acid to litmus, so that when heated slowly it becomes turbid at about 50° and a large flocculent coagulum separates at 55°. Heated to 65° for some time and filtered, a second coagulum may be obtained on raising the heat from 65° to 100°. The amount of this second coagulum is about one-third that of the first.

The coagulated proteid is dissolved by 0.5 p. c. KOH solution, but not perceptibly by 0.4 p. c. HCl solution, unless the latter is heated, when a clear transparent jelly is formed.

Freed from coagulable protein, the aqueous extract still contains a relatively large amount of substance which has the reactions of proteose.

When the concentrated aqueous extract is poured into a large volume of distilled water, a turbidity forms at first, which mostly disappears after shaking, indicating the absence of a notable quantity of globulin held in solution by the salts dissolved from the meal.

Saturation of the extracts with sodium chloride gives a considerable precipitate, only a small part of which can be

redissolved in dilute salt solution. When this dissolved part is precipitated by again saturating with salt, it also is converted, to a large extent, into an insoluble form; the part still remaining in solution is, like a globulin, precipitated by dialysis.

When the solution saturated with sodium chloride is filtered, and the diluted filtrate saturated with ammonium sulphate, a part of the precipitate produced, when redissolved in water, is thrown out of solution by saturating with sodium chloride, though before precipitation with ammonium sulphate it dissolved in saturated sodium chloride solution.

These reactions show that changes occur which involve the albumin coagulating at 55°, for after freeing the extract from all protein precipitable by saturating with salt or by dialysis, there remains in solution only a small proportion of this albumin.

Thus, an aqueous extract corresponding to 666 grams of germ meal, when heated to 65°, yielded 62 grams of coagulum, or 9.3 p. c.; a similar extract on dialysis deposited 9.2 p. c.; only 0.87 p. c. of coagulable and 2.0 p. c. of uncoagulable protein remaining in solution. The precipitate, produced by dialysis, was but slightly soluble in salt solution, having become largely coagulated. From these facts it is clear that one and the same protein substance gives rise to these apparently different protein bodies, and consequently the substance which O'Brien considered to be a globulin of the myosin type and an albumin, coagulating at 80°, are in fact derivatives of the albumin which coagulates mostly at 65°.

The cause of these changes was not determined, though it seems most probable that they are the result of a slow development of acid in the extract, which by uniting to the protein, in increasing proportions, forms chemically different substances. Such a development of acid takes place rapidly in muscle plasma, under the influence of which quite similar changes in the proteins there present can be observed.

Why Frankfurt overlooked albumin, present in such large proportion in the aqueous extract, is not easily understood, unless, before heating his solutions, he either added no acid or too much, so that he converted this substance into an uncoagulable acid compound.

Hydrochloric acid added to the extract in very small quantity causes a flocculent coagulum to separate on heating,

while a slightly larger quantity, added before heating, entirely prevents the formation of this coagulum. Acetic acid and nitric acid give precipitates in the extracts which are not soluble in a reasonable excess of either of these acids.

In order to determine definitely the relations of these variously obtained substances, we have made a large number of fractional precipitations under quite different conditions, an account of which we now give:

An extract was made by treating 700 grams of germ meal with seven times its weight of water, straining through bolting cloth and filtering the fluid perfectly clear. This was slightly colored, perfectly neutral to litmus, alkaline to lacmoid and strongly acid to phenolphthalein. A portion of it was at once heated for one hour in a water bath at 60°, and the large coagulum produced was filtered out, washed thoroughly with hot water and with alcohol and dried over sulphuric acid, giving 24.0 grams of preparation **1.**

Another preparation was made by heating in a water bath at 65°, 2,000 cc. of a clear aqueous extract, obtained by treating 3,000 grams of the germ meal with 9,000 cc. of water. The coagulum produced, when washed with hot water and alcohol and dried over sulphuric acid, weighed 62 grams, forming more than 9 p. c. of the oil-free germ meal. This is preparation **2.**

Another aqueous extract was heated at 65°, until all the proteid coagulable at this temperature had separated. The coagulum produced, when washed with hot water and alcohol was dried over sulphuric acid and found to weigh 16.68 grams. The filtrate from this coagulum, heated in a boiling water bath, yielded a second coagulum which, when washed and dried, formed preparation **3,** weighing 4.9 grams.

A portion of the extract, which yielded preparation 1, was saturated with ammonium sulphate, the resulting precipitate was dissolved as far as possible in water, its solution filtered clear and dialyzed for four days. During this time a considerable precipitate formed, that, when filtered out, was found to be insoluble in salt solution. The solution, filtered from that substance and dialyzed in running water until nothing more separated, was filtered and heated at 60°, which caused a coagulum. This coagulum, washed with hot water and with alcohol

and dried over sulphuric acid, weighed 7.1 grams and made preparation **4.**

In a clear water extract of wheat germ meal, dialyzed four days, there appeared a dense turbidity, due apparently to a globulin, since it dissolved on adding sodium chloride. Passing carbon dioxid gas through the dialyzing solution seemed to increase the turbidity, but effected no definite separation. As it was found that 10 cc. of $N/_{10}$ HCl per 100 cc. of the extract caused a separable precipitate, this proportion was added and the resulting flocculent precipitate brought into solution again by adding salt. The clear extract was then dialyzed for two days in running water and filtered from an amorphous precipitate, which was treated as later described on p. 326.

The filtrate from this precipitate was further dialyzed for three days more in running water and then, as nothing separated, for four days more into alcohol. The precipitate which resulted was dried over sulphuric acid, exhausted with water, in order to remove all uncoagulated proteids, as well as other soluble substances, dehydrated with absolute alcohol, again dried and weighed, yielding 12.0 grams of preparation **5.**

Another aqueous extract was saturated with pure sodium chloride, the abundant precipitate filtered out, treated with dilute brine and the resulting solution filtered from a relatively considerable quantity of insoluble matter. This filtrate was saturated with sodium chloride, a second precipitate filtered out and likewise treated with dilute salt solution. The insoluble portion was removed by filtration and the clear filtrate dialyzed. The small precipitate separated by dialysis was washed and dried, weighed 4.8 grams and formed preparation **6.**

The filtrate from the first precipitation of the substance of preparation **6,** caused by saturating its solution with sodium chloride, as described above, was diluted with water and saturated with ammonium sulphate. The precipitate which resulted was dissolved in water and its solution precipitated by saturating with sodium chloride. Although this substance had previously been soluble in saturated brine, after precipitation with ammonium sulphate it was found to be nearly all insoluble therein, so that almost complete precipitation resulted on again

saturating with sodium chloride. The precipitate so produced was filtered out, dissolved in dilute salt solution and reprecipitated by dialysis. We thus secured 7.6 grams of preparation **7**.

By saturating another aqueous extract of germ meal with sodium chloride a very large quantity of proteid was separated, which was filtered out, exhausted with dilute salt solution and washed thoroughly with water and alcohol. Dried over sulphuric acid, the preparation, **8**, weighed 17 grams.

The filtrate and saline washings from preparation **8** were united and again saturated with salt, and yielded a small precipitate which, dissolved in brine and precipitated by dialysis, gave preparation **9**, weighing 2.8 grams. As the salt-saturated solution from which this preparation had separated contained so little protein, it appears that nearly all the proteid precipitated from the aqueous extract by saturating with salt had been converted into the insoluble substance forming preparation **8**.

The filtrate, from the salt saturation-precipitate produced in the aqueous extract, was dialyzed in water for several days and the still clear solution then dialyzed in alcohol for 24 hours. The proteid, thereby precipitated in a coagulated state, was filtered out, washed with water and then with alcohol, yielding 12.4 grams of preparation **10**.

Another aqueous extract was saturated with sodium chloride and the precipitate, treated in the same way as preparation **8**, yielded 18.0 grams of preparation **11**.

The saline washings of the last preparation were dialyzed free from chlorides and gave a precipitate weighing 2.86 grams when washed and dried, which formed preparation **12**, having the properties of a globulin, dissolving readily on adding salt and being precipitated from such solution by water.

The filtrate from the final precipitation of **12**, when heated in a boiling water bath, gave a coagulum which formed preparation **13**, weighing 1.64 grams.

The salt-saturated filtrate from the first precipitation of **11**, as already described, was heated to boiling and the coagulum produced was filtered out, giving preparation **14**, weighing 5.47 grams.

Since analysis showed that most of the preparations already described contained phosphorus, some even in large amount,

we made an attempt to separate the phosphorus from our extract, in order to determine, if possible, the relation of the preparations free from phosphorus to those which contained much phosphorus.

Two thousand grams of meal were treated with 6 liters of distilled water and the extract (four liters) was squeezed out as completely as possible in a press.

As a preliminary experiment, 100 cc. of this clear, filtered extract were made faintly alkaline to phenolphthalein, with about 40 cc. of $N/_{10}$ KOH solution. To insure a sufficient quantity, 20 cc. more of alkali were added and thereupon a little calcium chloride, which gave a precipitate that seemed to partly dissolve on adding sodium chloride. The undissolved part, when washed with dilute salt solution, water and alcohol and dried, weighed 1.7 p. c. of the meal, contained about 55 p. c. of organic matter and left 45 p. c. of ash, consisting of tricalcium phosphate.

To 2,000 cc. of the original extract were then added 1,350 cc. of a solution containing alkali equivalent to 1,560 cc. $N/_{10}$ solution, with sodium chloride enough to form 6.5 p. c. of the total liquid. To this, a solution of calcium chloride was added, as long as a precipitate formed, and after standing over night the solution was decanted from the precipitate and filtered clear on a pulp filter. Of the clear filtrate, 2,200 cc. were made as neutral as possible to *litmus,* by adding 180 cc. of $N/_{10}$ HCl solution. Of the thus neutralized solution, 1,000 cc. when gradually heated in a water bath, became turbid at 52° and a considerable coagulum separated at 53°. After the temperature had been slowly raised to 65° and kept at this point for some time, the coagulum was filtered out, washed and dried as usual, giving preparation **15,** weighing 6.4 grams. Another portion of this extract, filtered from the calcium chloride precipitate, was saturated with ammonium sulphate while still slightly alkaline to litmus, the resulting precipitate filtered out, dissolved in water, its solution filtered clear and dialyzed. A slight precipitate formed on dialysis, which was removed by filtering, the solution was heated in a boiling water bath and the proteid thus coagulated was filtered out, washed, dried and weighed as usual, giving 3.07 grams of preparation **17.**

To determine what effect the removal of the phosphorized

substance thrown out by calcium chloride had upon precipitation with salt, we made neutral to litmus a liter of the filtrate from the calcium chloride precipitate and then saturated with sodium chloride. The large precipitate which formed was washed by decantation with water, in which it gradually dissolved, until only an insignificant quantity remained. The similarly obtained precipitate from the simple aqueous extract we have shown on page 315, to be nearly all insoluble in water.

To separate globulin from the aqueous extract, 1,200 cc. of clear filtered extract were obtained from 200 grams of the germ meal treated with 2,000 cc. of water. 1,000 cc. of this extract were dialyzed in running water for six days, and the large precipitate resulting filtered out, washed with water and alcohol and dried over sulphuric acid, giving preparation **18**, weighing 9.17 grams.

These preparations, thus variously obtained from the aqueous extract, were dried to constant weight at 110° and analyzed with the following results, most of the figures given in the table being the average of closely agreeing duplicate determinations:

TABLE I.—COMPOSITION OF PREPARATIONS OF PROTEID FROM THE WATER EXTRACT OF THE WHEAT EMBRYO.

	1.	**2.**	**3.**	**4.**	**5.**	**6.**	**7.**	**8.**	**9.**
Carbon	51.13	50.52	50.17	52.39	51.77	52.13	52.73	43.59	52.28
Hydrogen	6.85	6.81	7.01	6.83	6.81	7.04	7.11	5.77	6.97
Nitrogen	16.28	16.47	16.66	16.20	16.11	16.48	16.00	15.16	16.38
Sulphur	1.18	1.17	1.00	1.32	1.30	1.49	1.53	0.90	1.39
Phosphorus	0.72	0.97	0.91	trace	0.17	0.06	none	3.38	0.07
Ash	2.73	2.90	3.03	0.35	1.39	0.43	0.39	13.04	0.44
P_2O_5 in Ash	1.88	2.09	1.91	trace	0.47	trace	none	6.73	trace

	10.	**11.**	**12.**	**13.**	**14.**	**15.**	**16.**	**17.**	**18.**
Carbon	51.21	46.67	51.87	....	51.95	51.65	....	52.02	49.59
Hydrogen	6.85	6.19	6.89	....	6.86	6.66	....	7.00	6.68
Nitrogen	16.18	15.89	16.65	16.31	16.08	16.02	16.09	16.45	16.34
Sulphur	1.10	0.93	1.19	1.35	1.60	1.13	1.12	1.24	0.91
Phosphorus	0.46	2.53	trace	trace	trace	trace	trace	none	1.85
Ash	2.19	8.17	0.38	0.45	0.32	1.09	2.83	0.56	2.50
P_2O_5 in Ash	1.11	5.71	trace	trace	trace	trace	trace	none	1.79

Assuming that those of the foregoing preparations which contain phosphorus are compounds of protein with the nucleic

acid, which was separated from the aqueous extract of wheat germs and the composition of which is given on page 309 of this paper, and also assuming that all the phosphorus of these preparations is a part of the nucleic acid, we have calculated the composition of these preparations free from nucleic acid. The analyses were further calculated ash-free by subtracting the P_2O_5 contained in the ash from the total ash, which seems permissible since the ash consisted almost wholly of metaphosphates of potassium and sodium, strongly indicating that the P_2O_5 was derived from the nucleic acid. These calculations gave the following results:

TABLE II.—COMPOSITION OF LEUCOSIN CONTAINED IN THE PREPARATIONS FROM WATER EXTRACTS OF THE WHEAT EMBRYO.

	1.	2.	3.	4.	5.	6.	7.	8.	9.
C	52.93	52.75	52.41	52.57	52.57	52.47	52.93	53.23	52.64
H	7.12	7.16	7.38	6.85	6.91	7.08	7.13	7.09	7.02
N	16.45	16.68	16.94	16.26	16.27	16.55	16.06	16.30	16.46
S	1.29	1.32	1.13	1.32	1.34	1.50	1.53	1.60	1.41
O	22.21	22.09	22.14	23.00	22.91	22.40	22.35	21.78	22.47
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

	10.	11.	12.	13.	14.	15.	16.	17.	18.
C	52.63	52.44	52.06	----	52.11	52.16	----	52.30	53.45
H	7.06	7.10	6.92	----	6.88	6.73	----	7.04	7.30
N	16.40	16.26	16.71	16.38	16.13	16.20	16.56	16.54	16.57
S	1.17	1.34	1.19	1.35	1.60	1.14	1.15	1.24	1.16
O	22.74	22.86	23.12	----	23.28	23.77	----	22.88	21.52
	100.00	100.00	100.00		100.00	100.00		100.00	100.00

Of these preparations **1, 2, 3, 4, 13, 14, 15, 16** and **17** were obtained by coagulation with heat, **5** and **10** by coagulation with alcohol, **8** and **11** by saturation with sodium chloride, **6, 7, 9** and **12** by dialyzing salt solutions in water, and **18** by direct dialysis of the aqueous extract. Since some of these preparations formed the whole of the precipitable proteid contained in the extract, while others represented fractions, it is evident that all contain one and the same protein substance mostly combined with various proportions of nucleic acid.

Eliminating the nucleic acid, it thus appears that the composition of the protein part of those preparations which contain phosphorus is the same as that of the phosphorus-free proteid

preparations, although the former contain from very little up to more than 37 p. c. of nucleic acid.

Most of these preparations might, in accordance with custom, be called nucleoproteids, while **8** and **11** are, both in properties and composition, very much like nuclein. It is thus evident that these nucleoproteids and nucleins are nucleic acid compounds of protein which, owing to the high molecular weight of the nucleic acid, are more readily recognized as compounds than are those with acids of low molecular weight.

It is to be noted that these preparations show very diverse properties; some being like albumin; some like globulin; some being precipitated by saturation with salt, while others are not. As we have shown, these different properties are the result of changes caused by varying the conditions under which the proteid exists in the extract, and depend chiefly on the degree of acidity of the extract, whereby the numbers and kinds of acid molecules that combine with the protein molecule are altered.

Whatever may be the true cause of these changes, it is evident from the results here described, that the distinctions heretofore made between globulin and albumin, myosin and vitellin, etc., have very little value as a basis for classifying protein substances. This explains the difference between O'Brien's classification of leucosin as a myosin-like globulin, to which reference was made at the beginning of this paper, and our designation of it as an albumin, because of the ready solubility in water and coagulability by heat of the preparations which we had made.

Thus, preparation **18**, weighing 9.17 grams, was insoluble in water and in salt solution and was not a precipitate of globulin, since in the filtrate from which it had separated on dialysis, only 0.87 gram of coagulable albumin were found instead of 9.5 grams as usually found by direct coagulation of the aqueous extracts; moreover the analysis shows it to be a compound of leucosin with 20 p. c. of nucleic acid.

On the preceding pages, it was shown that a small part of the precipitate, produced by saturating the aqueous extract with sodium chloride, is soluble in dilute salt solution and can be precipitated from this solution by dialysis, as a globulin-like substance, readily soluble again in salt solution. The precipitates thus obtained contain little or no nucleic acid, and have very nearly the same elementary composition as leucosin, of which

they are evidently compounds with a small proportion of some body of low molecular weight.

It is plain from these facts that O'Brien's myosin contains the same protein substance as my leucosin.

O'Brien's *"albumin"* coagulating at 75°–80° is unquestionably more of this same leucosin as shown by preparation **3**, which formed about 25 p. c. of the total coagulable proteid. It has been the writer's experience that complete coagulation, especially in a solution quite free from salts, can be effected, if at all, only by heating the solution much above the lower coagulation temperature of the proteid to be separated.

From the whole seed we obtained leucosin with the same composition and general properties as from the embryo, but our preparations from the whole seed were free from phosphorus. This was probably because the proportion of nucleic acid to protein matter was smaller in the whole seed than in the embryo so that on extracting with water the nucleic acid did not form soluble compounds with the leucosin, but remained undissolved in combination with protein. In the following table is given the average of analyses of leucosin from the cereals.

TABLE III.—COMPOSITION OF LEUCOSIN PREPARED FROM VARIOUS CEREALS.

	Wheat Embryo.	Wheat Kernel.	Rye Kernel.	Barley Kernel.	Barley Malt.	Maize* Kernel.
C	52.65	53.02	52.97	52.81	53.07	52.72
H	7.04	6.84	6.79	6.78	6.72	7.05
N	16.43	16.80	16.66	16.62	16.71	16.82
S	1.32	1.28	1.35	1.47	23.50	1.32
O	22.56	22.06	22.23	22.32		22.05
	100.00	100.00	100.00	100.00	100.00	100.00

In an earlier paper on the Chemical Nature of Diastase (Jour. Am. Chem. Soc. XVIII, 542; Report Conn. Agr. Exp. Sta., 1895, p. 239) we pointed out that diastatic action appeared to be always associated with leucosin. Since our extracts

* This proteid was described by Chittenden and Osborne, Am. Chem. Jour. XIII, 327, as a myosin-like globulin, and was later, Jour. Am. Chem. Soc. XIX, 525, designated maysin by the writer. Since we now find that leucosin may form compounds having the properties of globulin, it is probable that maysin and leucosin contain one and the same protein substance.

of wheat embryo were so rich in leucosin, we determined the diastatic power of the germ meal by extracting with four times its weight of water and found that, under the conditions of Lintner's test, 0.10 cc. of the extract so made, when added to 10 cc. of a 2 p. c. solution of soluble starch, formed within one hour, at 20°, enough sugar to reduce 5 cc. of Fehling's solution. The 0.10 cc. of extract corresponds to 25 milligrams of the germs, from which it is seen that this meal possesses high diastatic power, though it is inferior in this respect to active malt.

Sodium Chloride Extract.

Wheat germ meal treated with 10 p. c. sodium chloride brine forms a dense jelly-like mass from which it is nearly impossible to separate the solution.

With 3 p. c. brine a manageable extract can be made by using from six to ten times as much solvent as meal. Thus, 100 grams of the meal treated with 600 cc. of 3 p. c. salt solution yielded in fifteen hours 400 cc. of clear filtrate. As has just been shown, the aqueous extract on dialysis, in consequence of a change which affects leucosin, deposits a large amount of proteid, chiefly in the coagulated form. In order to obtain preparations of the proteid substance soluble in salt solutions, but insoluble in water, which should be free from this coagulable albumin, we treated 2,000 grams of germ meal with 20 liters of 3 p. c. salt solution heated to 70°, whereby the leucosin was coagulated and the salt-soluble globulin brought into solution. The extract, neutral to litmus, was filtered clear, at once saturated with ammonium sulphate and the proteids thus precipitated collected on a filter, dissolved in water and the clear solution dialyzed in running water.

Proteid matter separated on dialysis in spheroids which, like legumin, conglutin and amandin, united to a plastic mass on the bottom of the dialyzer.

This precipitate was dissolved in brine, filtered absolutely clear, dialyzed for 48 hours, the large precipitate which separated allowed to settle, and the solution, which was nearly free from protein, decanted.

A portion of the precipitate was washed first with water, which rendered it opaque and dense, then with dilute and finally

with absolute alcohol and dried over sulphuric acid. This weighed 5.22 grams, and is preparation **19.** The rest of the precipitate was completely dissolved in 125 cc. of 10 p. c. salt solution. To this, water was added until its volume was 425 cc., thus making a salt solution of nearly 3 p. c. From this diluted solution a gummy deposit separated from which the fluid was soon completely decanted. The latter was further diluted with 325 cc. of water and the precipitate which resulted allowed to settle to a viscid transparent deposit. From this precipitate the solution was again decanted and dialyzed for 48 hours, but not more than a trace of globulin was deposited. The two precipitates produced by dilution were thoroughly washed with water and alcohol, dried over sulphuric acid and formed preparations **20** and **21,** weighing respectively 11.4 grams and 8.15 grams. A part of each of these preparations was set aside for analysis and the rest, dissolved together in 10 p. c. salt solution, allowed to stand over night at 4°. The solution was then decanted from a slight sediment, filtered clear and heated to 80° in order to coagulate any leucosin which might be present, and after two hours filtered from a very small coagulum which had gradually formed.

This filtrate was dialyzed in water for four days and the globulin which separated was washed with water and with alcohol and dried over sulphuric acid, giving preparation **22.**

The solution filtered from the first dialysis precipitates which yielded preparations **19, 20** and **21,** was further dialyzed; a little globulin, which separated, was filtered out and the filtrate dialyzed into alcohol for four days. A precipitate was produced which, when washed with absolute alcohol and dried, weighed 25.0 grams. This substance consisted of proteid which will be described later, on p. 328. Another series of fractional precipitations of this globulin-like proteid was made by extracting four kilograms of the oil-free germ meal with 27 liters 3 p. c. brine, heated to 67° at the time it was applied to the meal. The mixture was thoroughly stirred and thrown on filters. A clear filtrate of about 12 liters was finally obtained, which was saturated with ammonium sulphate. The precipitate produced was dissolved in water and its solution dialyzed for forty-eight hours, whereupon a large quantity of spheroids separated which

on settling united to a coherent mass. This precipitate was washed by decantation with water, dissolved in brine and its solution made faintly alkaline to litmus by cautiously adding $N/_{10}$ KOH solution. In order to separate phosphoric acid, a little calcium chloride solution was then added to this very slightly alkaline liquid and the latter, though apparently free from any precipitate of calcium phosphate, was filtered, whereby a little suspended matter was removed. The solution was made exactly neutral to litmus by adding 56 cc. $N/_{10}$ HCl and dialyzed for 18 hours. A gummy precipitate, A, adhering to the bottom of the dialyzer, then separated, from which the solution, B, was decanted almost completely.

The precipitate, A, was dissolved in about 200 cc. of 5 p. c. brine and the liquid was poured into 800 cc. of water. The resulting flocculent precipitate settled rapidly to a coherent deposit from which the solution was decanted. The deposit was repeatedly washed by decantation with water, which caused it to lose its gummy character and become opaque, white and granular. After dehydrating with absolute alcohol and drying over sulphuric acid it weighed 15.5 grams and was marked preparation **23.** The solution marked B was further dialyzed for 48 hours, when a second precipitate formed, which, like **23,** completely dissolved in brine, to a solution perfectly neutral to litmus. This precipitate was washed by decantation with water, but the finer part settled so slowly that it was necessary to decant it together with the water. The sediment after exhausting with absolute alcohol and drying, weighed 23.5 grams, and formed preparation **24.** On long standing, the decanted washings deposited the finely divided matter, which was then collected on a filter, dissolved in brine and its solution precipitated by water, giving 15.4 grams of preparation **25.**

To determine the quantity of globulin contained in our oil-free germ meal, we treated 200 grams of the meal with 2,000 cc. of 3 p. c. salt solution heated to 65° and filtered the extract perfectly clear. Of this, 1,000 cc. were dialyzed until free from chlorides, when the precipitate of spheroids was filtered out, washed with water and with alcohol and dried over sulphuric acid. This preparation, **26,** formed 5.05 p. c. of the oil-free meal.

To obtain a quantity of this globulin for digestion with pepsin, a quantity of germ meal was extracted with 3 p. c. salt

solution heated to 70°, the extract was filtered clear and saturated with ammonium sulphate. The precipitate produced was dissolved in water and the resulting gummy and somewhat turbid solution filtered clear. The filtrate was dialyzed until the solution gave no turbidity on pouring into distilled water. The proteid, which had then separated in spheroids, was filtered out, washed by decantation with water and with alcohol and dried over sulphuric acid, giving 27.3 grams of preparation **27**.

A part of the extract from which **27** had been prepared was mixed with an equal volume of $N/_{10}$ KOH, about twice the quantity necessary to neutralize the extract to phenolphthalein. The solution was then dialyzed in distilled water frequently renewed and in this way a considerable quantity of phosphorus was separated in the alkaline dialysate. When all, or nearly all, which it was possible to separate in this way, had been removed, the solution in the dialyzer was neutralized with $N/_{10}$ HCl until it no longer reacted alkaline to litmus. This caused a turbidity. The acid was then further added until an acid reaction with litmus was obtained, producing a precipitate from which, after settling, the solution was decanted. The precipitate was then dissolved in brine, its solution filtered clear and dialyzed, whereby a substance was precipitated in spheroids, which was filtered out, washed with water and alcohol and formed preparation **28**, weighing 3.0 grams.

These preparations had the following composition:

TABLE IV.—COMPOSITION OF PREPARATIONS EXTRACTED BY SODIUM CHLORIDE SOLUTIONS FROM THE WHEAT EMBRYO.

	19	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**
Carbon	----	----	48.77	50.03	50.23	48.17	49.39	48.75	49.79	48.67
Hydrogen	----	----	6.44	7.04	6.89	6.54	6.78	6.52	6.76	6.56
Nitrogen	18.14	18.21	18.12	18.39	18.23	18.06	17.95	18.16	18.01	17.97
Sulphur	0.49	0.56	0.51	0.60	0.53	0.55	0.48	0.63	0.61	0.61
Phosphorus	1.15	1.03	1.35	0.76	0.56	1.41	1.17	1.41	1.11	1.55
Ash	2.29	1.86	2.25	1.30	1.22	3.85	2.60	2.66	1.11	2.94
P_2O_5 in ash	1.66	1.34	1.68	0.84	0.80	2.00	1.82	2.00	0.68	2.30

These analyses, when calculated free from nucleic acid and ash, as was done for the albumin preparations, in the manner described on page 318, gave the following results:

TABLE V.—COMPOSITION OF THE GLOBULIN CONTAINED IN THE PREPARATIONS EXTRACTED FROM THE WHEAT EMBRYO BY SODIUM CHLORIDE SOLUTION.

	19	20	21	22	23
Carbon	----	----	51.37	51.58	51.40
Hydrogen	----	----	6.83	7.31	7.08
Nitrogen	18.59	18.59	18.62	18.70	18.45
Sulphur	0.57	0.63	0.60	0.66	0.57
Oxygen	----	----	22.58	21.75	22.50
			100.00	100.00	100.00
	24	**25**	**26**	**27**	**28**
Carbon	51.56	51.86	51.40	51.98	51.70
Hydrogen	7.07	7.19	6.94	7.12	7.05
Nitrogen	18.85	18.41	18.71	18.37	18.53
Sulphur	0.67	0.55	0.75	0.70	0.75
Oxygen	21.85	21.99	22.20	21.83	21.97
	100.00	100.00	100.00	100.00	100.00

These figures plainly show that our globulin preparations are mixtures of nucleates of one and the same protein substance and contain from 5 to 15 p. c. of nucleic acid. The preparations contain the same protein as the globulin which one of us has previously described as occurring in the kernel of wheat, rye, barley and maize. In the entire kernel, so little of this globulin is present that it is difficult to prepare it pure therefrom. For this reason, we think, the analyses given below do not agree as closely as they might otherwise be expected to. From the whole seed this globulin is obtained entirely free from phosphorus, which we attribute to the much greater proportion of proteid matter to nucleic acid, in the seed, compared with that existing in the wheat embryo.

TABLE VI.—COMPOSITION OF THE GLOBULIN CONTAINED IN VARIOUS CEREALS.

	Wheat Embryo.	Wheat* Kernel.	Rye† Kernel.	Maize‡ Kernel.	Barley§ Kernel.
Carbon	51.57	51.03	51.19	51.99	50.88
Hydrogen	7.07	6.85	6.74	6.81	6.65
Nitrogen	18.60	18.39	18.19	18.02	18.10
Sulphur	0.65	0.65	23.88	0.66	24.37
Oxygen	22.11	23.08		22.52	
	100.00	100.00	100.00	100.00	100.00

*Am. Chem. Jour., XV, 392.

†Jour. Am. Chem. Soc., XVII, 429, also Report of Conn. Expt. Station for 1894, p. 147.

‡Am. Chem. Jour., XIII, 327, 385 and XV, 20.

§Jour. Am. Chem. Soc., XVII, 539; also, Report Conn. Expt. Station for 1894, p. 165.

Having determined the composition of this globulin-like proteid and also that of the albumin, it became clear that several preparations obtained from the aqueous extract were mixtures of these two substances, thus showing the globulin to be present to some extent in the aqueous extract.

As noted, on page 314, when 2,000 cc. of an aqueous extract of about 650 grams of the meal were dialyzed in running water for four days, a dense turbidity was formed which could not be removed by filtration. This, however, on adding a little hydrochloric acid, was converted into a precipitate, which was readily dissolved by adding sodium chloride sufficient to make a 3 p. c. solution, and was precipitated from this solution by dialysis. We thus obtained 9.0 grams of preparation **29**, which, dried at 110°, had the following composition:

COMPOSITION OF PREPARATION **29.**

	I.	II.	Av.	Corrected for Ash & Nucleic Acid.	Calculated for 60 per cent globulin. 40 " " leucosin.
Carbon	48.30	47.92	48.11	51.70	51.95
Hydrogen	6.49	6.41	6.45	7.07	7.07
Nitrogen	17.40	17.24	17.32	17.74	17.74
Sulphur	0.83	0.85	0.84	1.08	0.91
Phosphorus	1.91		1.91	----	
Oxygen	----			22.51	22.53
Ash	3.95				
P_2O_5 in Ash	2.95			100.00	100.00

This analysis corresponds pretty nearly with that of a mixture of 60 p. c. of the globulin with 40 p. c. of leucosin, except that the amount of sulphur found was somewhat greater than that calculated.

After heating another portion of the same aqueous extract to 65° for some time and filtering off the coagulum, the filtrate was dialyzed for five days into alcohol and the precipitate thereby produced filtered out and exhausted with water. The residue of proteid matter coagulated by alcohol, weighing 6.7 grams and marked preparation **30**, was then dried at 110° and analyzed with the following results:

COMPOSITION OF PREPARATION **30.**

		Corrected for Ash and Nucleic Acid.	Calc. for. Globulin 40 p. c. Leucosin 60 p. c.
Carbon	49.49	51.80	52.13
Hydrogen	6.81	7.14	7.03
Nitrogen	16.87	17.32	17.30
Sulphur	0.93	1.14	1.05
Phosphorus	0.89	----	
Oxygen		22.60	22.49
Ash	4.00		
P_2O_5 in Ash	2.01	100.00	100.00

This analysis corresponds quite nearly with that of a mixture of 40 p. c. of the globulin with 60 p. c. of the albumin.

The Proteose of the Wheat Embryo.

In making the preparations already described considerable quantities of crude proteose were obtained from both the aqueous and sodium chloride extracts. After the leucosin and the globulin had been separated as completely as possible, the solutions containing the proteoses, as well as the unseparated residues of other proteids, were dialyzed into alcohol and the precipitates produced, washed and dried over sulphuric acid.

A mixture, weighing 15.4 grams, was made by uniting several such preparations that had been obtained from aqueous extracts from which most of the other proteids had been separated, without heat, by saturating with sodium chloride and dialysis into alcohol. The mixture contained much matter made insoluble in water by the final treatment with alcohol. This was filtered out, washed thoroughly with water and with alcohol and when dried weighed 4.18 grams, and was marked preparation **31.** The filtrate from this was saturated with ammonium sulphate, the precipitate redissolved and again precipitated in the same way. The solution of the second precipitate was dialyzed in cold distilled water, until free from sulphate, and then for several days in alcohol. The precipitate thus produced was dissolved in water, a little insoluble matter filtered out, and its clear solution saturated with sodium chloride, which produced a small precipitate. This was filtered out, dissolved, and its solution dialyzed in water. The salt-saturated filtrate was likewise dialyzed and when both solutions were free from chlorine the dialyzers were transferred to alcohol and the proteose thereby precipitated. The proteose separating on saturation with salt, gave 0.6 gram of preparation **32,** that from the salt-saturated solution, 0.97 gram of preparation **33.** This small yield of proteose indicates great impurity of the original crude product and shows that the proportion of proteose to other proteids is very small.

Another crude product was obtained by dialyzing into alcohol an aqueous extract, after separating leucosin which had

been coagulated by heat. This, weighing 35 grams, was dissolved in water and the insoluble matter filtered out, washed and dried, giving preparation **34,** weighing 7.26 grams.

The filtered solution was saturated with ammonium sulphate, the precipitate dissolved in water, and the clear solution dialyzed in distilled water until free from sulphates, and then in alcohol. The substance thus separated was again dissolved in water, and its solution saturated with salt; the precipitate thus produced was dissolved in water and its solution, as well as the salt-saturated filtrate, were dialyzed in water. When free from chlorine, these solutions were dialyzed in alcohol and yielded, respectively, preparations **35,** weighing 4.0 grams and **36,** weighing 1.84 grams.

Another preparation of crude proteose was obtained by extracting the meal with 3 p. c. sodium chloride solution heated to 70°, dialyzing the extract in water, coagulating the leucosin by heat and precipitating the proteose by dialysis in alcohol. A mixture of such preparations, weighing 31.6 grams, was treated with water, the insoluble matter filtered out, washed and dried, giving 5.16 grams of preparation **37.**

The filtered solution was saturated with ammonium sulphate, the precipitate dissolved in water, the solution dialyzed in distilled water till free from sulphate, and then in alcohol. The separated proteose was redissolved in water and its solution saturated with sodium chloride. The precipitate which resulted was filtered out, dissolved in water and its solution, as well as the salt-saturated filtrate, were dialyzed in water till free from chlorine, and finally in alcohol.

The products thus obtained, formed, respectively, preparations **38,** weighing 0.75 gram and **39,** weighing 1.35 grams. One other proteose preparation was made from the aqueous extract previously described on page 316 from which the phosphorus was largely separated by making it slightly alkaline and adding calcium chloride. After heating the extract to boiling and filtering out the coagulum, the filtrate was dialyzed into alcohol, the resulting precipitate dehydrated with absolute alcohol, dried over sulphuric acid, redissolved in water and precipitated by saturating with ammonium sulphate. The gummy precipitate, having the general appearance and proper-

ties of similar precipitates of the proteoses obtained by the action of pepsin, was dissolved in water, dialyzed free from sulphates and then precipitated by dialysis in alcohol, giving 2 grams of preparation **40.**

These preparations were dried at 110° and analyzed with the following results:

Composition of Alcohol-Coagula and of Proteose Prepared from the Wheat Embryo.

Table VII.

	Residues of other proteids coagulated by alcohol.			Proteose precipitated by sodium chloride.			Proteose soluble in saturated NaCl sol.			
	31	**34**	**37**	**32**	**35**	**38**	**33**	**36**	**39**	**40**
C	52.36	49.44	51.93		49.94		48.46	48.70	48.44	48.99
H	6.98	6.85	6.87		6.80		6.70	6.73	6.71	6.85
N	16.01	16.00	16.30	16.79	17.08	16.26	16.91	16.76	16.16	16.89
S	1.85	4.08	1.30		1.24		27.93	27.81	28.69	1.10
O	22.80	23.63	23.60		24.94					26.17
	100.00	100.00	100.00		100.00		100.00	100.00	100.00	100.00
Ash	0.81	14.13	0.95	----	0.30	0.77	1.13	1.00	0.74	1.27

From these analyses it is seen that the matter insoluble in water, forming preparations **31, 34** and **37,** consists of coagulated proteid apparently mostly derived from leucosin. The high proportion of sulphur in **31** and **34** is due to calcium sulphate, precipitated by alcohol from the aqueous extract.

The remaining preparations have the low percentage of carbon, characteristic of proteoses made by pepsin digestion.

Whether the proteose precipitated by saturating its solution with salt is a different protein substance from that soluble in saturated salt solution or whether difference in solubility is due to the presence of different acid compounds of one and the same protein substance, is not demonstrated, but the agreement shown by these analyses, considering the difficulty of making quite pure preparations, indicates that the latter is the case.

The Proportions of the Various Proteid Substances of the Wheat Embyro.

Twenty grams of fresh germ meal, from which the ether-soluble constituents had *not* been separated, were treated with 500 cc. of water and after shaking for some time, the extract was filtered clear. Two portions, of 100 cc. each, were treated with a few drops of very dilute hydrochloric acid and heated in a boiling water bath. The coagulum which separated was collected on a filter and its nitrogen determined. To the filtrate from one coagulum, tannin was added and nitrogen was determined both in the precipitate and in the filtrate. Another lot of 20 grams was treated in the same way and nitrogen determined in the heat-coagulum formed in each of two portions of 100 cc. The amount of nitrogen corresponding to one gram of germ meal was found in the four coagula to be, .0163 gram; .0156 gram; .0159 gram and .0162 gram; in the tannin precipitate .0062 gram and in the solution filtered from the latter .0062 gram.

Twenty grams of germ meal were extracted with 500 cc. of 3 p. c. sodium chloride solution heated to 70°, whereby the leucosin was coagulated and the globulin and proteose dissolved. Of the clear filtered extract, 100 cc. yielded with tannin a precipitate containing .0166 gram N per gram of meal extracted.

Two portions of the meal, each of one gram, were exhausted with 3 p. c. sodium chloride solution heated to 70°, and nitrogen determined in the residues. The .0331 and .0309 gram of nitrogen found in the residues were from the leucosin and insoluble nitrogenous bodies, so that the nitrogen belonging to the latter equalled .0171 gram and .0149 gram. From the average of these figures we find the following amounts of the different forms of nitrogen in one gram of the wheat germ meal.

	Nitrogen Grams.	
Insoluble in water and salt solution	0.0160	
Insoluble in water but soluble in salt solution	0.0100	= globulin nitrogen.
Soluble in water and coagulable by heat	0.0160	= albumin "
Soluble in water, uncoagulable by heat, precipitable by tannin	0.0050	= proteose "
Not precipitable by tannin	0.0060	= non-proteid "
Total	0.0530	
Found by direct nitrogen determination	0.0531	

We have shown that the coagulated leucosin preparations contain about 10 p. c. of nucleic acid, the globulin about 15 p. c., while those of the proteose contain none. Deducting these quantities from the nitrogen given in the table, we find 9.5 p. c. of the embryo to be leucosin, 4.84 p. c. to be globulin, and 3.03 p. c to be proteose.

The bodies which are represented by the insoluble nitrogen, we have been unable to separate from the embryo. The residue after extraction with hot salt solution contained .0076 gram of phosphorus. Since there was in this residue about .1000 gram of coagulated leucosin, in which we have usually found about 1 p. c. of phosphorus, we have .0061 gram of phosphorus remaining over. In view of the large proportion of nucleic acid found in the extracts of the embryo, it is not improbable that this phosphorus mostly belongs to nucleic acid, in which case there would be about 6.75 p. c. of nucleic acid containing .0108 gram of nitrogen, which leaves only .0052 of nitrogen for proteid matter in the insoluble residue. It seems probable therefore that this insoluble nitrogen largely belongs to compounds of the proteid with relatively much nucleic acid.

Digestion of the Phosphorus-containing Proteids with Pepsin-hydrochloric Acid.

Leucosin nucleate. Ten grams of the coagulated albumin, preparation 2, were suspended in 400 cc. of water and dissolved by adding 100 cc. of $N/_{10}$ KOH solution. To the nearly clear solution which resulted, an equal volume of 0.4 p. c. HCl was added, together with some pepsin, and the mixture digested at 37°. In a short time the solution became perfectly clear, but later deposited a large coherent precipitate, which gradually contracted, but at the same time retained the form of the lower part of the beaker. From this the clear solution was decanted, the precipitate thoroughly washed by decantation, suspended in water and dissolved by adding 28 cc. of $N/_{10}$ KOH solution, an amount of alkali just sufficient to dissolve all the substance and at the same time make the solution neutral to litmus. When to this solution decinormal acid was gradually added, no precipitate appeared until nearly one-half the quantity of acid required for complete neutralization

had been added, but with 28 cc., the solution was neutralized and also completely precipitated, the addition of 2 cc. more acid giving no turbidity in the solution filtered from the precipitate.

This precipitate was washed with water and with alcohol and dried over sulphuric acid, forming preparation **41**, weighing 1.54 grams.

To precipitate this substance a quantity of acid was added exceeding that of the alkali employed for solution by just 2 cc. The filtrate from the precipitate, however, required not 2 cc. of alkali, but 8.5 cc. for neutralization to phenolphthalein, showing 6.5 cc. of alkali to have been neutralized by the acid of the nuclein originally dissolved. The neutralized filtrate left on evaporation 0.3975 gram of substance, the aqueous solution of which was precipitated by hydrochloric or nitric acid, but *not* by ammonium molybdate solution until after boiling with acid for some little time, when yellow phosphomolybdate was precipitated. These facts indicate the presence in this filtrate of a nucleic acid.

More nuclein was made from the same preparation, **2**, by suspending thirty grams in 0.2 p. c. HCl, containing pepsin, which, even at 20°, caused within two hours complete solution of the coagulated proteid. The solution was digested at 37° for 48 hours, during which time much nuclein separated, having the appearance and properties of the preparation just described.

After decanting the clear solution and thoroughly washing the residual nuclein, the latter was suspended in water and dissolved in 72 cc. $N/_{10}$ KOH. The solution thus obtained was made neutral to litmus by adding 11 cc. of $N/_{10}$ HCl, but no precipitate appeared till 1.5 cc. more of acid were added. To the solution 72 cc. $N/_{10}$ HCl were added, giving a precipitate which, when washed and dried, made preparation **42** and weighed 3.4 grams. The filtrate from this precipitate, as in the former case, was strongly acid, requiring 12 cc. of $N/_{10}$ KOH to neutralize it to phenolphthalein. Two other preparations of nuclein were made from 8.493 grams of **8**, and 9.804 grams of **11**, both being substances precipitated from the aqueous extract by saturating with sodium chloride. Each portion was suspended in about 300 cc. of 0.2 p. c. HCl, containing 0.1 gram of pepsin and, with frequent stirring, digested at 40° for 24 hours. Throughout

the digestion a large part of the substance remained undissolved. An equal volume of 0.2 p. c. HCl, containing 0.1 gram of pepsin, was again added to each and the digestion continued for 24 hours longer. The insoluble matter which remained was not coherent like the two former nuclein products, but consisted of a white, very finely divided substance which was easily filtered out and washed. After dehydrating with absolute alcohol these preparations were dried over sulphuric acid; from **8**, 4.04 grams of preparation **43** were obtained and from **11**, 4.16 grams of **44**.

Globulin nucleate. Fifteen grams of a mixture of nearly equal parts of the globulin preparations **23** and **24** were next suspended in 0.2 p. c. HCl, containing 0.2 grams of pepsin, which, within a short time, almost completely dissolved the proteid matter. From this solution, on further digestion, the nuclein separated, forming a coherent deposit. After 72 hours digestion, the clear solution was decanted, the deposit dissolved in a little ammonia and its solution filtered perfectly clear from a very slight gelatinous residue. The resulting solution was then treated with acetic acid, added in excess of the amount necessary to neutralize the solution to litmus. Since, even on standing, the precipitate so produced separated imperfectly, an equal volume of alcohol was added. The substance, which then separated well, was filtered out, washed with dilute and with absolute alcohol and dried over sulphuric acid, giving 2.38 grams of preparation **45**, or about 16 p. c. of the original substance.

The filtrate from the acetic acid precipitate gave a further slight precipitate on adding HCl, which had properties characteristic of nucleic acid.

Still another preparation of nuclein was made from the globulin by suspending 10 grams of **27** in water and adding 50 cc. of $N/_{10}$ KOH. This solution was neutralized and an equal volume of 0.4 p. c. HCl at once added, producing a turbid solution, which, however, contained no visible particles. To this, pepsin was added and the mixture digested for 40 hours, during which time a coherent deposit of nuclein formed on the bottom of the beaker. From this the clear solution was decanted. The deposit was then thoroughly washed with water and dissolved in 43 cc. of $N/_{10}$ KOH. To this clear solution

43 cc. of $N/_{10}$ HCl were added, causing a gummy precipitate which could not be filtered until 15 cc. more acid had been added, when the precipitate rapidly settled as a coherent deposit, from which the solution was soon decanted. This solution required for neutralization to litmus 16 cc. $N/_{10}$ KOH, and to phenolphthalein 18 cc. The precipitate when washed and dried gave 2.2 grams of preparation **46.**

These six preparations were all dried at 110° and analyzed with the following results:

TABLE VIII.—COMPOSITION OF NUCLEIN FROM THE PROTEIDS OF THE WHEAT EMBRYO.

	41	**42**	**43**	**44**	**45**	**46**
Carbon	44.87	44.35	42.68	43.35	39.42	41.92
Hydrogen	5.82	5.77	5.45	5.47	5.03	5.25
Nitrogen	16.04	16.64	16.12	16.01	16.05	17.00
Sulphur	0.97	1.03	0.65	0.85	0.53	0.46
Phosphorus	4.58	5.07	5.32	4.88	5.27	5.63
Ash	0.60	0.78	1.72	1.72	17.42	1.17
P_2O_5 in Ash	0.29	0.55	1.24	0.94	10.56	0.69

If we subtract from the total ash the amount of P_2O_5 found in it, we shall have a determination of the bases contained in the ash of these preparations.

We have calculated these analyses of nuclein free from the bases of the ash and from nucleic acid, in the way previously described, with the following results:

TABLE IX.—COMPOSITION OF PROTEIN MATTER CONTAINED IN THE NUCLEIN.

	41	**42**	**43**	**44**	**45**	**46**
Carbon	53.65	54.77	51.80	52.36	52.30	51.64
Hydrogen	7.23	7.46	6.85	6.73	6.91	6.60
Nitrogen	16.68	17.56	16.31	16.31	19.31	18.93
Sulphur	1.98	2.37	1.61	1.89	1.53	1.25
Oxygen	20.46	17.84	23.43	22.71	19.95	21.58
	100.00	100.00	100.00	100.00	100 00	100.00

The composition of the proteid matter in **43** and **44** is very nearly that of leucosin except as regards sulphur, the amount of which is decidedly greater. On the other hand, **41** and **42**, which also were derived from preparations whose protein matter was leucosin, differ in composition very decidedly from

that substance. This is probably because on pepsin digestion the substance of preparations **43** and **44** remained throughout undissolved, whereas **41** and **42** separated on pepsin digestion from nearly clear solutions and therefore doubtless their protein matter had been to some degree altered by the pepsin before separating as an insoluble compound with nucleic acid. The two nucleins, **45** and **46**, from the globulin which also had separated from solution, show similar differences in composition when compared with the unaltered globulin, carbon and nitrogen being higher and sulphur very much higher than in the globulin. The greatly increased proportion of sulphur would indicate that sulphur in some acid form had split from the proteid molecules undergoing hydrolysis and had become a part of the insoluble nuclein, as did the nucleic acid.

Conclusion.

The embryo of the wheat kernel contains:

1. A *nucleic acid* in considerable quantity. This acid is insoluble in water, forms soluble as well as insoluble compounds with proteid substances, and on hydrolysis yields guanin, adenin, phosphoric acid and other products not yet identified. It has the following composition:

NUCLEIC ACID.

Carbon	36.48
Hydrogen	4.48
Nitrogen	16.17
Phosphorus	8.96
Oxygen	33.91
	100.00

This acid is not identical with any nucleic acid heretofore described. On hydrolysis it does not yield any form of sugar. From guanylic acid recently described by Bang it also differs distinctly, in that its potash salt is extremely soluble in cold water and the ratio of P to N, being 1 to 4 instead of 1 to 5.

2. *Leucosin,* an albumin, (yield about 10 p. c. of the embryo) formerly found by the writer in small quantity in the whole kernel of wheat, rye and barley, and abundantly in malt. Leucosin begins to separate as a flocculent coagulum when the very

slightly acid aqueous extract of the wheat kernel or wheat embryo is heated to 52°. Even after long heating at 65°, the leucosin is only partly separated, and about one-third more coagulum of the same elementary composition is obtained on raising the temperature from 65° to 100°.

By saturating extracts of the kernel or of the embryo with sodium chloride, the leucosin is largely precipitated, from the former as a substance readily soluble again in water, from the latter as an insoluble compound containing about 30 p. c. of nucleic acid. From the latter precipitate, dilute salt solution extracts a small amount of nearly phosphorus-free proteid, which behaves like a globulin, being precipitated by dilution or by dialysis, but having essentially the same ultimate composition as leucosin.

By dialyzing the aqueous extract in water, nearly all the leucosin contained in it is precipitated, not like a globulin, but as an insoluble compound containing about 20 p. c. of nucleic acid. The following figures give the average of accordant analyses, calculated nucleic acid free, of 18 different preparations representing complete as well as fractional precipitations under the above and other conditions. These figures agree closely with the composition of the leucosin of wheat, rye, barley and malt.

LEUCOSIN.

Carbon	52.65
Hydrogen	7.04
Nitrogen	16.43
Sulphur	1.32
Oxygen	22.56
	100.00

3. A globulin, precipitated in spheroids by dialysis and by dilution as a coherent deposit. The yield is about 5 p. c. of the embryo. The solution of this globulin in 10 p. c. sodium chloride brine becomes turbid on heating to about 87°, and at 90°, on continued heating, a considerable flocculent coagulum separates.

Our preparations of this globulin contained from 6 to 17 p. c. of nucleic acid, most of them from 12 to 15 p. c. From this the proteid could not be separated by fractional precipitation.

Analyses of 10 different preparations of this globulin gave very closely agreeing figures when calculated free from nucleic acid, the average of which is as follows:

GLOBULIN.

Carbon	51.57
Hydrogen	7.07
Nitrogen	18.60
Sulphur	0.65
Oxygen	22.11
	100.00

In composition and properties this globulin agrees with that found by the writer in the kernels of wheat, rye and barley. So far as we have been able to observe, it differs from edestin, the crystalline globulin obtained from seeds of hemp, flax and squash only in containing two-thirds as much sulphur.

4. *Proteose,* precipitated by saturating the aqueous extract, freed from globulin and albumin, with salt. One preparation, **35,** was phosphorus free, and had the following composition:

PROTEOSE.

Carbon	49.94
Hydrogen	6.80
Nitrogen	17.08
Sulphur	1.24
Oxygen	24.94
	100.00

5. *Proteose,* soluble in the salt-saturated solution filtered from the foregoing proteose and obtained free from phosphorus by precipitating with alcohol its solution freed from salt by dialysis. The average of analyses of four preparations of this proteose is the following:

PROTEOSE.

Carbon	48.65
Hydrogen	6.75
Nitrogen	16.68
Sulphur	1.10
Oxygen	26.82
	100.00

These proteoses together form about 3 p. c. of the embryo.

6. About one-third of the total nitrogen of the embryo is not extracted by water and salt solutions and appears to belong to insoluble compounds. This nitrogen is accompanied by phosphorus corresponding to about 6.75 p. c. of nucleic acid, which would contain two-thirds of this insoluble nitrogen. It seems probable, therefore, that this insoluble nitrogen belongs largely to insoluble compounds of nucleic acid and protein.

7. These phosphorus-containing preparations of globulin and leucosin, when digested with pepsin-hydrochloric acid, yield nuclein in proportion to the phosphorus which they contain. Calculated free from nucleic acid, the analyses of these nucleins show the protein constituent to have nearly the same composition as the proteid from which they were derived, the most marked difference being a greater proportion of sulphur in the former.

8. The proteids of the embryo differ from those of the dormant endosperm, of this as well as of other seeds, in the facility with which they undergo changes. These changes are the result of a redistribution of acids among the protein and other basic molecules, so that compounds form in the extracts of the embryo which contain various proportions of nucleic acid according to the changing conditions.

The writer has shown that the globulin, edestin, forms crystalline compounds with one and with two molecules of acid and also compounds with a greater number of acid molecules. There is reason to believe that all other native protein substances form similar compounds; in other words, that proteins are distinctly polyacid bases and that the acid characters which proteids display are due to acids united to their protein molecules, probably in the same manner as in the salts of the purin bases.

These nucleic acid compounds of the protein constituents of the wheat embryo appear to be compounds of this order. According to this view, no special distinction can be made between nucleins and nucleoproteids, the former being simply compounds containing a greater number of molecules of nucleic acid united to one molecule of protein.

That the wheat embryo in fact contained the same nucleic acid *compounds* as we have obtained from the extracts, is highly

improbable. All that we can conclude is that the embryo contains the different protein substances described, together with nucleic acid, and that these may unite to form a number of different compounds according to the conditions which prevail at any given time.

THE PROTEIDS OF THE EGG YOLK.

By Thomas B. Osborne and George F. Campbell.

The yolks of a large number of freshly laid hen's eggs were broken up by straining through a sieve and mixed with an equal volume of saturated pure sodium chloride brine. A somewhat turbid solution resulted, which was shaken out with about one-third its volume of ether, containing a little alcohol. After standing one night, a clear reddish ethereal layer separated, leaving the pale yellow aqueous solution almost clear. After shaking out a second time with ether the aqueous solution was dialyzed for forty-eight hours, whereupon a large quantity of proteid separated in spheroids which united to a salvy mass. This was freed, as far as possible, from the liquid, by draining on filters, redissolved in 10 p. c. brine and its solution dialyzed for three days. From the semi-solid mass thus obtained the liquid was decanted and the precipitate dissolved in 10 p. c. brine. A little transparent gummy substance (lecithin?) remained undissolved which rendered filtration very difficult. By filtering under considerable pressure on a thick layer of paper pulp about 700 cc. of *perfectly clear* filtrate, *a*, and 2,000 cc. of very nearly clear filtrate, *b*, were obtained. The latter, *b*, was dialyzed for four days, when the large deposit was filtered out and treated with about a liter of salt solution. A gelatinous, almost pasty mixture resulted, which was shaken out with ether. The two liquids at once separated, the ethereal being clear and strongly yellow in color and the aqueous almost perfectly clear and not at all gummy. Shaken out three times more with ether, this aqueous solution became suddenly opaque and gelatinous. The mass was dialyzed free from chlorides, the solid deposit was washed with alcohol and with ether and dried over sulphuric acid, giving preparation **1**, weighing 60 grams. The *clear* solution, *a* (700 cc.), was diluted with three volumes of distilled water, and allowed to stand over night at a temperature of 6°. The proteid, which had separated on

dilution, soon settled as a clear, transparent layer, from which the clear solution, *c*, was decanted completely. The proteid was readily and completely soluble in 10 p. c. brine to a perfectly clear pale yellow solution, which, when dialyzed until wholly free from chlorides, yielded the proteid in spheroids that subsequently united to a semi-solid mass. The latter was filtered out, washed thoroughly with water and with alcohol, and dried over sulphuric acid, giving 32.1 grams of preparation **2**. The solution, *c* (decanted from the precipitate produced by dilution that yielded **2**), was treated with 1,000 cc. more water. This caused a precipitate which within two hours formed a semi-fluid deposit. From this the solution *d* was decanted, and the deposit dissolved in brine yielding a perfectly clear solution, which was dialyzed until free from chlorides.

The proteid thus precipitated was filtered out, washed with absolute alcohol as long as anything could be removed thereby and then dried over sulphuric acid, giving preparation **3**, weighing 16.5 grams.

The solution, *d*, was dialyzed free from chlorides, the precipitated spheroids were filtered out, washed with absolute alcohol and dried over sulphuric acid, making 5 grams of preparation **4**.

The solution, page 339, filtered after forty-eight hours' dialysis from the substance that yielded the foregoing preparations, was further dialyzed until almost all its dissolved proteid had separated.

The precipitate thus produced was filtered out, dissolved in brine and the solution shaken out three times with ether. On shaking out the third time, the solution suddenly changed to an opaque jelly. This was then placed in a dialyzer, and when all the salt had been removed, the insoluble proteid was washed with absolute alcohol until everything soluble therein was extracted. Dried over sulphuric acid, this preparation, **5**, weighed 75 grams. All these preparations were dried at 110° and analyzed with the following results:

	1	2	3	4	5
Carbon	50.82	51.21	51.10	50.69	50.48
Hydrogen	7.11	7.07	7.21	7.06	7.11
Nitrogen	16.04	16.11	16.23	16.40	15.50
Sulphur	1.11	1.05	1.00	1.05	1.02
Phosphorus	0.91	0.81	0.79	1.20	0.96
Ash	2.37	2.49	1.56	3.23	3.19
P_2O_5 in Ash	1.65	1.79	1.14	2.30	2.15

The ash of all these preparations consisted of sodium metaphosphate containing about 70 p. c. of P_2O_5. We have therefore subtracted from the total ash its P_2O_5, the remainder representing the ash to be deducted in calculating the percentage composition of the proteid substance.

Any chlorine or sulphur that might belong to the ash would necessarily be lost during incineration.

Calculating these preparations free from ash, as thus corrected, we have:

	1	2	3	4	5
Carbon	51.18	51.56	51.31	51.16	51.00
Hydrogen	7.14	7.12	7.24	7.12	7.18
Nitrogen	16.16	16.23	16.30	16.55	15.66
Sulphur	1.12	1.06	1.00	1.06	1.03
Phosphorus	0.92	0.82	0.79	1.21	0.97
Oxygen	23.48	23.21	23.36	22.90	24.16
	100.00	100.00	100.00	100.00	100.00

1 and **5** represent the two main fractions that weighed 60 and 75 grams respectively; while **2, 3** and **4** represent fractions of **1**, whose weights were respectively 32, 16.5 and 5 grams.

In composition all are nearly alike. A little more phosphorus was found in **4** than in the other preparations, probably because a larger proportion of some phosphorus-containing acid was combined with the protein of this final, very soluble fraction, which formed less than 10 p. c. of the total vitellin.

We have not yet succeeded in preparing this phosphorized acid free from proteid. The body, which we have thus prepared from egg yolk and analyzed, is not present, as such, in the egg, for the proteid substances of the yolk are readily and wholly soluble in salt solution, whereas all these preparations are entirely insoluble in salt solution. Insolubility in the cases of **2, 3** and **4** was caused by washing with alcohol, which at the same time removed much lecithin. Lecithin was not present as an admixture, but was chemically combined with the proteid, forming a compound soluble in saline solutions and having the properties of globulin, as is shown by the following experiments.

A. The alcoholic washings from the three successive fractions, **2, 3** and **4**, were evaporated and left residues of crude

lecithin weighing 6.4796, 3,5913 and 1,3150 grams respectively. Adding these quantities to the weights of the corresponding fractions dried at 110°, we have the amounts of lecithin-protein compound originally composing them. These contained 18.00, 19.4 and 22.23 p. c. of lecithin respectively.

B. The yolks of two eggs were directly extracted with ether until practically nothing more was removed. The residual matter was then, as far as possible, dissolved in 10 p. c. salt solution, filtered perfectly clear and the solution diluted with water until an abundant precipitate separated. This was filtered out, dissolved in salt solution and filtered perfectly clear. This solution and that filtered from the precipitate previously produced by diluting with water were separately dialyzed.

The proteid precipitates thus obtained were filtered out and washed with water and alcohol. The part precipitated by dilution was found to contain 17.5 p. c. of lecithin, that which remained in the diluted brine, 22.3 p. c.—results in pretty close accord with those already stated.

C. Part of a large quantity of yolk vitellin which had suddenly become insoluble on shaking with ether, was thoroughly washed with water and then completely extracted with alcohol until all the lecithin, equal to 13.31 p. c., was removed. The solution, from which the above large quantity of insoluble proteid had originally separated, still contained a little protein matter and was therefore saturated with ammonium sulphate and the salt solution of the precipitate so produced was dialyzed. The substance which then separated in spheroids, after thorough washing with water, was still readily soluble in salt solution, but when washed with alcohol became insoluble and yielded to the alcohol 24.2 p. c. of lecithin.

Hoppe-Seyler considered this lecithin to be chemically combined with the proteid, with which view our experience is in full harmony. It is not possible that such large quantities of lecithin are simply admixed with the protein matter, for were this the case it could be readily removed by ether. Furthermore we could not dissolve a mixture of globulin and lecithin in brine and obtain a clear solution easy to filter. That the proteid should unite with lecithin is to be expected, since protein readily combines with acids. We must, accordingly, consider the protein of egg yolk to be largely, if not wholly, a lecithin

compound which, dissolves in salt solution, and behaves like a globulin.

Saline extracts of egg yolk, like those of plant-seeds, contain, according to circumstances, mixtures of compounds of the protein molecule with several different numbers of molecules of lecithin, of which the more soluble compounds contain the larger number of acid molecules.

That we find such a large proportion of lecithin in these compounds is accounted for by its great molecular weight. If the molecular weight of the protein were 15,000,* its compound with four molecules of lecithin would contain over 17 p. c. of the latter.

Although we are not yet in a position to distinguish between these several compounds, it is nevertheless now necessary to make a distinction between the vitellin as it exists in the yolk, combined with lecithin, and the insoluble substance free from lecithin, which we have prepared and analyzed. As the designation vitellin has generally, if not always, been understood to apply to a protein substance, we suggest that this term be henceforth reserved for the protein, which in egg-yolk is united to lecithin and not to the compounds formed by their union, which may more properly be called lecithin-vitellin.

These considerations raise the question, are the preparations analyzed, vitellin, as defined above, or are they compounds of this protein with some other, at present unknown substance. Since the preparations yield paranuclein on digestion with pepsin, it appears highly probable that they contain paranucleic acid, but in less proportion than occurs in paranuclein.

To test this hypothesis we treated 10 grams of preparation **5** with 100 cc. of $N/_{10}$ KOH solution, and after standing some time added enough 0.4 p. c. hydrochloric acid to neutralize the alkali and give an excess of acid equal to 0.2 p. c. of the solution. Pepsin was then intermixed and the solution digested at 40° for forty hours. After some time a voluminous precipitate separated from the nearly clear liquid. This was filtered out, washed thoroughly with water and mixed with 45 cc. $N/_{10}$ KOH solution, which dissolved the precipitate and just neu-

*We have pointed out in a former paper, Jour. Am. Chem. Soc., XXI, 486, the reasons which make it probable that the weight of the protein molecule may be about 15,000.

tralized its acid reaction to phenolphthalein. This solution was filtered perfectly clear and 45 cc. of $N/_{10}$ HCl were added, which threw out the paranuclein as a voluminous gelatinous precipitate. This was filtered out, washed thoroughly with water and with alcohol, and dried over sulphuric acid. This preparation, **6**, weighed 2.38 grams. Another preparation of paranuclein was made by suspending 50 grams of preparation **5** in 2/10 p. c. hydrochloric acid, adding pepsin and, after digesting for twenty-four hours, adding more acid and pepsin and continuing the digestion twenty-four hours longer. The insoluble paranuclein was then filtered out, washed thoroughly with water and with alcohol, and dried over sulphuric acid. It weighed 15.7 grams. Preparation **7**.

The yolks of 120 eggs were mixed with an equal volume of saturated sodium chloride brine and the mixture was shaken with ether containing a little alcohol. A perfectly clear red-yellow ether-layer and a clear pale yellow aqueous layer soon separated. The ether was drawn off and the aqueous solution again shaken with ether, which caused a part of the proteid to become insoluble, rendering the solution opaque and gelatinous. After the ether had separated, the aqueous solution was dialyzed until free from chlorides, when it was filtered and the very voluminous precipitate was suspended in four liters of 0.2 p. c. hydrochloric acid and digested with 3.0 grams of pepsin. After twenty-four hours the solution was decanted from a large deposit of insoluble matter, the latter was mixed with about one-third its volume of 0.4 p. c. hydrochloric acid and the digestion continued forty-eight hours longer, whereby the amount of insoluble matter was much reduced. The latter was then filtered out and repeatedly extracted with alcohol until the evaporated alcoholic washings left no residue. This required a large quantity of alcohol and more than a week of time. The residue, air dried, weighed 32 grams and formed preparation **8**.

These preparations were then dried at 110° and analyzed, with results as follows:

COMPOSITION OF PARANUCLEIN.

	6	7	8
Carbon	46.69	47.72	44.48
Hydrogen	6.77	6.80	6.52
Nitrogen	14.66	14.64	14.34
Sulphur	0.86	0.94	0.82
Phosphorus	3.29	2.52	4.19
Ash	1.89	5.01	3.43
P_2O_5 in Ash	0.83	2.47	1.61

Assuming that the yolk proteid and the paranuclein are both compounds of paranucleic acid, we should be able to calculate the composition of the protein substance in our preparations if we knew the composition of this acid. Unfortunately we do not know this acid in the free state.

Liebermann and others have thought that paranucleic acid is identical with metaphosphoric acid, but we think it extremely improbable that metaphosphoric acid can exist in animal tissues.

In seeking to harmonize the analyses of paranuclein with those of the paranucleoproteid we find that they are brought into more or less accordance by reckoning them free from ash and from certain phosphoric acid radicals. Assuming that the hydrogen of the phosphoric acid is replaced by protein, we have "corrected" our analyses for the following phosphoric acids, viz.: HPO_3, H_3PO_4, $H_8P_2O_9$ and H_5PO_5 by subtracting from the ash its P_2O_5 and to the remainder (the bases) adding the phosphorus and oxygen of the respective acids and, after deducting their sum from 100, recalculating these remainders to percentage statements.

Corrected for PO_3 we find no satisfactory agreement, as is shown by the following figures obtained by thus correcting the analyses of preparations **2** and **6**.

	2	6
Carbon	52.68	50.86
Hydrogen	7.28	7.37
Nitrogen	16.57	15.97
Sulphur	1.08	0.94
Oxygen	22.39	24.86
	100.00	100.00

Correcting for the other three acids, however, we find a close agreement between all the analyses of the preceding preparations as is seen in the following tables:

COMPOSITION OF THE PARANUCLEOPROTEID AND THE PARANUCLEIN CALCULATED FREE FROM PO_4 AND ASH.

	Paranucleoproteid.					Paranuclein.		
	1	2	3	4	5	6	7	8
Carbon	52.67	52.89	52.59	53.14	52.57	52.54	53.17	52.12
Hydrogen	7.37	7.30	7.42	7.40	7.40	7.60	7.57	7.64
Nitrogen	16.62	16.64	16.70	17.19	16.11	16.50	16.31	16.80
Sulphur	1.15	1.09	1.03	1.10	1.06	0.96	1.05	0.96
Oxygen	22.19	22.08	22.26	21.17	22.86	22.40	21.90	22.48
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

The agreement of these figures makes it plain that the paranuclein consists of one or more compounds of the protein (vitellin) containing a larger proportion of the same acid that exists in the paranucleoproteid from which it originated. These protein compounds with paranucleic acid are therefore analogous to those with the nucleic acid which we have obtained from the wheat embryo and described in the preceding paper.

If, as many seem to think, the paranucleic acid is not in fact H_3PO_4, it may be found to be either $H_8P_2O_9$, or H_5PO_5. These acids differ in composition so little from H_3PO_4 that we find nearly or quite as close agreement when the analyses are calculated free from either of them, as the following table shows, in which is given the result of calculating the analyses free from P_2O_9 and ash.

COMPOSITION OF THE PARANUCLEOPROTEID AND THE PARANUCLEIN CALCULATED FREE FROM P_2O_9 AND ASH.

	Paranucleoproteid.					Paranuclein.		
	1	2	3	4	5	6	7	8
Carbon	52.79	53.00	52.70	53.31	52.71	53.05	53.56	52.78
Hydrogen	7.39	7.32	7.44	7.42	7.42	7.69	7.63	7.74
Nitrogen	16.66	16.67	16.74	17.25	16.19	16.66	16.43	17.02
Sulphur	1.15	1.08	1.03	1.10	1.06	0.98	1.05	0.97
Oxygen	22.01	21.93	22.09	20.90	22.62	21.62	21.33	21.49
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Considering the great differences in phosphorus-content of these preparations, the striking agreement of the analyses thus calculated makes probable that the acid combined with the protein has nearly the composition H_3PO_4 and contains little, if any organic matter, or else contains an organic radical, whose composition is very nearly like that of the protein itself.

It may possibly be a methyl or ethyl phosphoric acid or some other quite simple organic phosphoric acid, but probably not so complex an acid as glycerophosphoric, as we have found a wide difference between the analyses when corrected for this acid.

It seems probable in view of these facts that further study will lead to the isolation and positive identification of this acid.

Conclusion.

Sodium chloride solutions dissolve from egg yolk a large amount of protein matter which has the properties of a globulin, being precipitated by diluting or dialyzing its solutions.

The substance soluble in salt solution consists of a mixture of compounds of protein matter with lecithin. Preparations of these compounds contain from 15 to 30 p. c. of lecithin. The more soluble products obtained by fractional precipitation contain larger proportions of lecithin than the less soluble, that is, they are more acid compounds. These compounds might well be called lecithin-nucleo-vitellin.

The lecithin thus combined is not removed by ether, but readily by alcohol. The insoluble lecithin-free proteid, obtained by treating the lecithin compounds with alcohol, has a constant composition when obtained from successive fractional precipitations of the lecithin compound. The following is the average of five accordant analyses representing fractional precipitations of the substance:

Composition of Nucleo-Vitellin.

Carbon	51.24
Hydrogen	7.16
Nitrogen	16.38
Sulphur	1.04
Phosphorus	0.94
Oxygen	23.24
	100.00

This substance on digesting with pepsin yields paranuclein of variable composition. When the analyses of the nucleovitellin and the paranuclein are calculated free from phosphoric acid H_3PO_4, possibly identical with "paranucleic acid," the composition found for the organic part of all of these preparations is so nearly the same as to show that the proteid and the nuclein are both compounds of one and the same proteid body, vitellin, with a phosphoric acid, possibly H_3PO_4, $H_8P_2O_9$, or some very simple organo-phosphoric acid. The composition of the organic part of the preparations calculated free from H_3PO_4 gives as the average for eight preparations of the paranucleoproteid and the paranuclein the following figures:

COMPOSITION OF VITELLIN.

Carbon	52.71
Hydrogen	7.46
Nitrogen	16.64
Sulphur	1.05
Oxygen	22.14
	100.00

THE PROTEIN CONSTITUENTS OF EGG WHITE.

BY THOMAS B. OSBORNE AND GEORGE F. CAMPBELL.

A recent paper by the writer (Report of this Station for 1898 and Jour. Am. Chem. Soc. **21**, 486) gave an account of preparations of crystallized egg albumin which justified the conclusion that with the substance commonly called ovalbumin there is associated one or more other protein bodies, the properties of which were not definitely ascertained.

We have since repeated this work on a larger scale and have not only confirmed the former observations, but have obtained much additional information respecting these other protein bodies.

FRACTIONAL PRECIPITATION OF EGG WHITE.

Six liters of the whites of freshly laid eggs were gradually and carefully mixed with an equal volume of saturated ammonium sulphate solution and formed the precipitate A, which was filtered off.

To the filtrate saturated ammonium sulphate solution was added until a small permanent precipitate was produced, and then a mixture of 600 cc. of saturated ammonium sulphate solution, 830 cc. of water and 27 cc. of concentrated hydrochloric acid were gradually added. After standing over night, the large quantity of fine needle-shaped crystals which separated, fraction B, was filtered out.

The filtrate, mixed with saturated ammonium sulphate solution until a small precipitate again formed, was allowed to stand over night, during which time another crystalline precipitate, C, separated.

By treating the filtrate from C in the same manner, another precipitate, D, was obtained, which consisted wholly of spheroids.

All the protein matter which remained in the filtrate from D was precipitated by saturating the solution with ammonium sulphate, and this made preparation E. These several fractions were then further divided as follows:

Precipitate A was treated with water, strained with difficulty, owing to its gummy character, through bolting cloth, and the slightly turbid solution thus obtained was dialyzed for several days. The considerable mucin-like precipitate which separated was filtered out, washed with much water and dehydrated with absolute alcohol, giving 26.88 grams of preparation A.1.a.

The filtrate from the precipitate of A.1.a., saturated with ammonium sulphate, yielded a precipitate which was treated with a little water, and the part insoluble therein filtered out; the filtrate was allowed to evaporate until an amorphous precipitate separated. This precipitate was filtered out, united with the insoluble part of the ammonium sulphate precipitate, dissolved in water, and its solution dialyzed, yielding a precipitate which resembled that previously obtained by dialysis, being largely composed of gummy, mucin-like clots. This, when well washed with water and alcohol and dried, gave 7.28 grams of A.1.b. The dialyzed solution from which A.1.b. had separated, when treated with ammonium sulphate, yielded a precipitate which was filtered out, pressed on filter paper, dissolved in water and this solution dialyzed free from sulphate.

This dialyzed solution, evaporated at 40°, left a residue, marked A.2, weighing, dry, 16 grams.

The solution containing sulphate of ammonium, from which had been separated the substance yielding the two last named preparations, was further concentrated by gradual evaporation, and yielded a mass of needle-shaped crystals. These were separated by filtration, dissolved in water, the solution was dialyzed till free from ammonium sulphate and evaporated at 40°, giving preparation A.3, weighing 11.56 grams.

Precipitate B. This, consisting wholly of well-formed crystals, was dissolved in water and treated with saturated ammonium sulphate solution, which was added until precipitation began. After standing over night, the wholly crystalline precipitate was filtered out and the filtrate, marked b.2, treated as will be later described. The precipitate was again dissolved in water and enough ammonium sulphate added to give a precipitate from which, after a time, the solution was decanted. After pressing out the mother liquor, the precipitate was dissolved in water and the clear solution dialyzed, until wholly free from sulphate, when it was evaporated at 50°, giving 36.0 grams of B 1.

The filtrate from the precipitation of B.1 treated with more ammonium sulphate, on standing twelve hours, deposited a large crop of finely developed crystals. This was filtered out and, treated in the manner described for B.1, gave 59 grams of B.2. The filtrate from B.2 was added to solution b.2.

Precipitate C. The filtrates from B.1 and B.2, forming solution b.2, were united with the aqueous solution of fraction C, ammonium sulphate was added to incipient precipitation and the mixture was allowed to stand over night. The substance, which separated in spheroids, was filtered out, dissolved in water and recrystallized by adding ammonium sulphate. On standing, the substance deposited in large aggregates of crystals, extending from the bottom of the dish in warty masses, some of them more than 2 cm. long and 0.5 cm. in diameter. These masses were wholly composed of exceptionally large and well-formed needle crystals. After separating from the mother liquor, this crystalline mass was dissolved in water and the solution dialyzed till free from sulphate, and, evaporated at 50°, gave 45 grams of C.1.

The filtrate from C.1, on standing, yielded a very large quantity of substance which was composed almost wholly of crystals, only a very few spheroids being detected among them. This precipitate, by the treatment applied to C.1, yielded 106 grams of C.2.

The filtrate from the first precipitation of C.1 was treated with more ammonium sulphate, the filtrate from C.2 was added, and the mixture allowed to evaporate slowly until a precipitate separated, which consisted of a mixture of crystals and spheroids. This yielded C.3, weighing 32.5 grams.

Precipitate D. This was dissolved in water, ammonium sulphate solution was added and the mixture allowed to stand until a considerable separation of spheroids occurred, which, on settling, formed a clear, transparent deposit on the bottom of the dish.

After several reprecipitations, always without obtaining crystals, and thinking that the absence of crystals might be due to a deficiency of acid, we added to the solution 3 cc. of concentrated hydrochloric acid mixed with much ammonium sulphate solution. On standing, however, this solution, as before, deposited only spheroids. The deposit, after decanting the solution, was dissolved in water and its solution, after adding ammonium sulphate to incipient precipitation, was allowed to evaporate slowly. When considerable deposit had formed, the solution was decanted and allowed to concentrate until nearly all the remaining proteid matter had formed a coherent deposit of spheroids. These two deposits were each separately dissolved in water, their solutions dialyzed free from ammonium sulphate and evaporated to dryness at 50°, thus giving D.1, weighing 30 grams and D.2, weighing 20 grams.

The solution, decanted from the first precipitate which separated after adding acid, gave on evaporation a precipitate consisting wholly of spheroids, which formed D.3, weighing 55 grams. The solution from this, on further concentration deposited nearly all the dissolved protein in the form of spheroids which, by the usual treatment, gave 10 grams of D.4.

Precipitate E. This, when dissolved in water, yielded a brilliant yellow solution, slightly acid to litmus. Thereto saturated ammonium sulphate solution, containing 1 cc. of concentrated hydrochloric acid, was added, which, on standing, caused

a precipitate. This was filtered off, dissolved in water, ammonium sulphate was added to incipient precipitation, and after standing seven days, the deposit of spheroids which had separated was filtered out, yielding 6.2 grams of E.1. The filtrate contained no protein matter.

The filtrate from the first reprecipitation of E was mixed with ammonium sulphate until a considerable amorphous precipitate had formed. This was filtered out, dissolved in water, and after adding ammonium sulphate and allowing the solution to stand six days, it gave a precipitate of spheroids which yielded E.2, weighing 15.65 grams.

The solution decanted from the first precipitation of E.2, after evaporating for six days, gave a deposit of spheroids mixed with a little amorphous matter, which was marked E.3, and weighed 22.5 grams.

We thus obtained from six liters of egg white, seventeen different fractions, containing 504 grams of substance, 262 grams of which were wholly crystalline, and since at least one-half of C.3 consisted of crystals, the total amount of crystalline matter was 278 grams. Evidently more than one-half the protein constituents of egg white can be crystallized. The yield of crystallized albumin was about the same as that obtained by the writer in his previous investigation, being about 4.4 grams of crystallized albumin per 100 cc. of egg white, as against 5.3 and 4.9 grams previously obtained.

Fractions E.2 and E.3. Since the fractions E.2 and E.3 appeared, by their behavior on heating with water, to contain at least three protein substances, the greater part of each preparation was treated with water. E.2 contained some matter insoluble in water which could not be filtered out, while E.3 gave a clear solution. Both solutions, heated in a water bath, gave a flocculent coagulum at 58° which, even after heating at 65° for some time, could not be filtered out. The temperature was therefore raised to 72° and held there some time, which caused more coagulum to separate in both solutions, but as the solutions could not even then be filtered, the bath was heated to boiling. With the rising temperature the coagulum rapidly increased, so that it could soon be filtered out on cloth. After thoroughly washing each coagulum with hot water and alcohol and drying over sulphuric

acid, we obtained preparations E.2.a, weighing 6.0 grams and E.3.a, weighing 8.6 grams. The clear bright yellow filtrates from these were united and poured into several volumes of alcohol, which threw out a white precipitate and held the yellow coloring matter in solution.

The precipitate, E.4, washed with alcohol and ether and dried over sulphuric acid, weighed 5 grams.

These preparations were then dried to constant weight at 110° and analyzed.

The heat coagulation points of their solutions, containing 2.5 p. c. of the protein substance and 10 p. c. of sodium chloride, were determined by gradually heating in a water bath. In Table I, page 354, T indicates the temperature at which the solution became turbid and F that at which flocks separated.

The specific rotation was determined with a Schmidt and Haensch polarimeter, the readings on the sugar scale being converted into degrees of circular polarization by multiplying by 0.346.

In the table the percentages of nitrogen marked K, were found by the Kjeldahl process, those marked A, by the Dumas or absolute method.

These results entirely confirm those given in our former paper, but in consequence of the more extended series of fractional precipitations in the work now under discussion we have plainer evidence of the presence of the several protein constituents of the egg white.

Of these fractions, B.1, B.2, C.1 and C.2 consist of ovalbumin, separated in a completely crystalline condition, and, with the exception of a trace present in C.2, are wholly free from the lower coagulating albumin, thus demonstrating this latter to be a distinct substance. The rotation and elementary composition of these fractions are essentially the same as that given in our former paper for similar products.

In fraction E.4 we have ovomucoid not coagulated by heat, with a specific rotation of 61.°5 and of the same composition as Möner[1] and Zanetti[2] found for this substance. (1 Zeit. f. physiol. Chem. **18**, 525 and 2, Ann. di Chim. e Farmac., No. 12,, 1897.) The successive fractions, from C.3 to E.3.a inclusive, all have a higher specific rotation and contain a relatively con-

TABLE I.—THE WEIGHT, ROTATION, COMPOSITION AND HEAT COAGULA TEMPERATURES OF THE FRACTIONAL PRECIPITATES OF EGG-WHITE.

			Calculated Ash-free.								
Prepara-tion.	Weight grams.	$[a]_D$	C.	H.	N.	S.	P.	O.	Ash.	Coagula-tion tem-perature.	Remark
A.1.a.	26.88	−21° 9′	50.69	6.71	14.49	2.280	trace	25.830	0.53	T 70° F 75°	Coagulum no appears on bo reappears on
A.1.b.	7.28	—	50.95	6.85	14.82	1.938	none	25.442	1.41	—	
A.2.	16.00	−31° 50′	52.76	7.12	15.48K 15.58K	1.687	0.123	22.770	0.41	T 64° F 70°	Practically agulated above
A.3.	11.56	—	52.40	7.12	15.77K 15.66K	1.729	0.002	23.029	0.28	T 66° F 70°	
B.1.	36.00	−29° 53′	52.59	7.10	15.59K 15 51K	1.613	0.126	23.021	0.136	T 70° F 71°	None coa below 70°.
B.2.	59.00	−29° 13′	52.78	7.09	15.54K 15.60A	1.619	0.127	22.814	0.150	T 68° F 70°	None coa below 68°.
C.1.	45.00	−30° 2′	52.75	7.31	15.57A 15.43K	1.613	0.131	22.696	0.350	T 69° F 71°	None coa below 69°.
C.2.	106.00	−30° 48′	52.79	7.00	15.57K 15.63A	1.634	0.126	22.850	0.20	T 62° F 65°	Only a trace lated at this te ture. The rest ated at 70° and
C.3.	32.40	−34° 2′	52.24	7.08	15.55A	1.755	0.085	23.290	0.290	T 57° F 57°	Considerable lated below 7 most above 70°.
D.1.	30.00	−34° 18′	52.41	6.93	15.57A	1.796	0.106	23.188	0.14	T 51° F 53°	Much coag below 70°, but above 70°.
D.2.	20.00	−37° 14′	52.29	6.94	15.61A	1.886	0.062	23.212	0.04		
D.3.	55.00	−41° 22′	51.62	6.94	15.23A 15.27K	1.972	0.048	24.170	0.10	T 52° F 55°	About 50 p c. lated below 60°, 35 p.c. at 70° and The rest did n agulate.
D.4.	10.00	−51° 30′	50.56	6.80	13.64A 13.54A	1.997 2.017	trace	27.033	0.11	T 62° F 64°	Aqueous solut heating, formed jelly. Salt sol. lated at 64°. above. Muc agulated.
E.1.	6.20	−33° 36′	51.91	6.94	15.02A 15.27K	1.700 1.710	trace	24.285	0.49	T 59° F 60°	Probably abo p c. was coag below 70°, much 70°.
E.2.	15.65	−43° 7′	—	—	—	—	—	—	—	—	Less appeared agulate below 70 of E 1 when hea water with no sa
E.3.	22.50	−49° 5′	—	—	—	—	—	—	—	—	Less separated 70° than of E.2. heated in water.
E.2.a.	6.00	—	52.40	6.91	15.69A	1.780	0.090	23.131	0.66	—	Not much sepa below 70° when h in water.
E.3.a.	8.60	—	51.94	6.84	15.31A	1.629	0.045	24.236	0.36	—	Not much sepa below 70° when h in water.
E.4.	5.00	−61° 38′	49.02	6.45	12.71A	2.379	0.11	29.441	0.750	—	No coagulum.

siderable amount of an albumin coagulating at a much lower temperature than ovalbumin.

The fractions C.3, D.1 and D.2 have nearly the same rotation, temperatures of coagulation and composition. We therefore subjected these to fractional precipitation, in order to determine whether they were mixtures of different proteids or were essentially one substance. The greater parts of these preparations were accordingly united, dissolved in about 400 cc. of water and saturated ammonium sulphate solution added, until a decided precipitate had formed. This was filtered out, freed from mother liquor, dissolved in water, the solution dialyzed until free from ammonium sulphate and then evaporated to dryness below 50°. The residue, F.1, weighed 7.5 grams. The filtrate from F.1, on evaporating at the room temperature, deposited a quantity of spheroids, mixed with a few crystals of ovalbumin. This deposit was filtered out, dissolved in water, to the solution saturated ammonium sulphate solution was added until incipient precipitation set in, and the whole was allowed to stand until a considerable precipitate composed of spheroids mixed with a few crystals had formed. This was filtered out and, in order, if possible, to convert the whole into crystals, the original reaction of the egg white was imitated by making the aqueous solution of the precipitate slightly alkaline with ammonia. A very small excess of hydrochloric acid was added and then ammonium sulphate to incipient precipitation, thus reproducing, as closely as we could, the conditions under which the first crystalline separation had been obtained. After standing, a precipitate formed which contained no crystals. This was filtered out and, by the usual treatment, gave F.2, weighing 18.32 grams. The solutions filtered from the two preceding precipitations of F.2 were saturated with ammonium sulphate, and the resulting precipitate dissolved in water, its solution dialyzed, and evaporated below 50°, gave F.2.a, weighing 7.83 grams. The filtrate from the first precipitation of F.2 on further evaporation gave a precipitate of spheroids which was dissolved in water, and by the treatment employed for separating F.2.a, gave 16.7 grams of F.3.

The solution filtered from the second precipitation of F.3 was saturated with ammonium sulphate and from the precipitate produced by the usual treatment, F.3.a, weighing 5.38 grams,

obtained. These several preparations were found to have the rotation, heat coagulation temperatures and compositions given in Table II.

TABLE II.—COMPOSITION, ETC. OF FRACTIONAL REPRECIPITATIONS OF TH INTERMEDIATE FRACTIONS OF TABLE I.

			Ash free.								
Prep.	Weight grams.	[a] D.	C.	H.	N.	S.	P.	O.	Ash.	Coagulation temperature.	Remarks.
F.1.	7.50	36° 4′	52.01	7.03	15.77D	1.768	0.069	23.353	0.36	T 58° F 64°	First Coagulu small, above 7 more than F.2.a.
F.2.	18.32	32° 2′	52.36	6.95	15.59K 15.43K	1.689	0.117	23.374	0.47	T 68° F 68°	Only a trac below 70°, muc above 70°.
F.2.a.	7.83	38° 35′	51.54	6.94	15.19K 15 22K	1.920 1.900	0.081	24.319	0.60	T 60° F 63°	Considerabl below 65°, abov 70° more than F.3.a.
F.3.	16.70	40° 11′	51.32	6.72	15.34K	1.782 1.810	0.009	24.815	0.32	T 58° F 59°	Below 67° near ly 35 p.c., at 70° and above nearl 40 p.c. coagulated
F.3.a.	5 38	44° 25′	51.29	6.77	15.30D	2.025	0.027	24.588	1.06	T 62° F 64°	More below 6 than in any these fractions F.

While none of these fractions was obtained free from the lower coagulating albumin, the relative proportions of the two albumins which the different fractions contained varied greatly, which fact, in conjunction with their rotation and composition, shows that a decided, though incomplete, separation has been effected.

In order to separate more completely the proteids which these mixed fractions appeared to contain, we dissolved 13.4 grams of D.3 in 500 cc. of 10 p. c. brine, and heated the filtered and perfectly clear solution slowly in a large water bath. A flocculent coagulum began to separate at 52°, which, after heating for some time at 60°, was filtered off. The filtrate was then removed and this coagulum was washed with pure water, which, after the salt was removed, dissolved the coagulum almost completely. From these washings the proteid was separated by adding alcohol. When dried over sulphuric acid it weighed 5.00 grams and formed preparation D.3.1.

The solution filtered from the coagulum separating below 60°, when further heated became turbid at 64° and yielded a flocculent coagulum at 70°. This second coagulum was filtered off

after heating for some time at 88° and when washed and dried gave 3.5 grams of D.3.2. The filtrate from this gave no more coagulum on heating and after dialyzing free from chlorides was concentrated to small volume and precipitated by pouring into alcohol. This gave us 2.0 grams of D.3.3.

Seven grams of F.3 were dissolved in 280 cc. of 5 p. c. brine and the solution heated to 67°. The flocculent coagulum, which began to separate at 59°, was filtered out, washed and dried, giving 1.87 grams of F.3.1. The filtrate heated to 92° gave another coagulum which began to separate at about 70°. This, when dry, weighed 2.17 grams, F.3.2. The filtrate from F.3.2, dialyzed free from chlorides and precipitated by alcohol, gave 1.39 grams of F.3.3.

Twenty-five grams of K.3 (the more soluble part of a precipitate obtained by adding an equal volume of saturated ammonium sulphate solution to a large quantity of egg white) were dissolved in about 800 cc. of 10 p. c. brine, the solution filtered clear and heated to 60°. The coagulum was washed with salt solution, suspended in water after passing through fine bolting cloth to break up all lumps, washed thoroughly with water, and with alcohol, and was dried, giving 2.78 grams of K.3.1. Unlike ovalbumin, this coagulated proteid separated in a finely divided state, so that it could be easily washed through the cloth.

The filtrate from this coagulum was dialyzed free from chlorides and then evaporated to dryness below 60°, leaving a residue which weighed 17.2 grams and had a specific rotation of 37°.55′. This rotation being much greater than that of ovalbumin, the whole of this residue was dissolved in 10 p. c. brine, the solution heated in a boiling water bath, the coagulum, K.3.2, filtered off, the filtrate dialyzed free from chloride and the clear solution poured into alcohol. The substance, K.3.3, thus precipitated, weighed dry, 1.39 gram, and consisted of ovomucoid as shown by its rotation, 61° 30′.

The preparation K.3 was prepared from the precipitate produced by half saturating the egg white solution with ammonium sulphate, which precipitate is commonly supposed to consist almost wholly of globulin. Nevertheless our results show that K.3 contained about 11 p. c. of the albumin coagulating below 65°, 83.0 p. c. of ovalbumin and over 5 p. c. of ovomucoid.

That so much of this latter substance should be present in this preparation is surprising and shows the difficulty in separating ovomucoid from ovalbumin.

All these preparations were analyzed with the results given in Table III.

TABLE III.—COMPOSITION, ETC. OF PRODUCTS DERIVED FROM FRACTION D. F. AND K.

			Ash free.								
Preparation.	Weight grams.	$[a]_D$	C	H.	N.	S.	P.	O.	Ash.	Coagulation temperature.	Remarks.
D.3.1.	5.00	—	52.19	6.84	16.10K	1.67	0.010	23.19	0.85	T 48° F 52°	Formed about 4 p.c. of D.3.
D.3 2.	3.81	—	52.08	7.04	15.36	1.61	0.110	23.80	0.23	T 64° F 70°	Formed about 3 p.c. of D.3.
D.3.3.	2.00	61° 10′	48.90	6.61	12.16K	2.34	none	29.99	2.33	—	No coagulum. Formed about 18 p.c. of D.3.
F.3.1.	1.87	—	—	—	16.03K 16.15K	17.3	trace	—	1.19	T 58° F 59°	Formed about 27 p.c. of F.3.
F.3.2.	2.17	—	—	—	15.16K	1.61	—	—	2.00	T 70° F 70°	Formed about 31 p.c. of F.3.
F.3.3.	1.39	61° 20′	—	—	—	—	—	—	—	—	No coagulum. Formed about 20 p.c. of F.3.
K.3.1.	2.78	—	52.31	7.05	16.16K	1.71	trace	22.77	0.56	T 57° F 60°	Formed about 11 p.c. of K.3.
K.3.3.	1.39	61° 30′	—	—	—	—	—	—	—	—	Formed about 5.5 p.c. of K.3.

These figures show that an albumin coagulating at 55°-57° forms nearly 50 p. c. of the products obtained from D.3. This albumin contains somewhat less carbon, decidedly more nitrogen and a little more sulphur than ovalbumin. Since it so closely resembles ovalbumin, and is so intimately associated with it the writer suggests that it be called *conalbumin*. The rest of the products from D.3 consist of about 35 p. c. ovalbumin and 18 p. c. ovomucoid. From F.3, 27 p. c. of conalbumin, 31 p. c. of ovalbumin and 20 p. c. of ovomucoid were obtained.

This investigation of the protein constituents of the egg white shows them to be ovomucin, ovalbumin, conalbumin and ovomucoid. These have the following properties:

Ovomucin is a glycoproteid recently discovered by Eichholz (Jour. of Physiology, **23**, 167), to be present in small amount in egg white. This substance, precipitated by diluting egg white, has heretofore been regarded as globulin, but we find that nearly, if not quite, all of that which is so precipitated, is ovomucin.

From the whites of 240 eggs we obtained, although with some loss, 34.2 grams of ovomucin or about 7.0 p. c. of the proteid matter of the egg white, which is the proportion in which Dillner found the "globulin" to be present.

When freshly precipitated by dilution or dialysis, ovomucin loses its gummy character on thoroughly washing with water, but, when treated with salt solutions, forms a transparent gummy mass, which on agitation yields a clear but viscid solution.

When washed with alcohol and dried, ovomucin forms a light, white powder, partly soluble in sodium chloride brine, and gives a solution free from viscidity, which becomes turbid at 75°, and yields flocks at 78°. On boiling, this coagulum almost wholly dissolves and reappears on cooling.

Eichholz states that ovomucin dissolves in dilute sodium carbonate solutions. We find, however, that when treated with much 1 p. c sodium carbonate, only an apparent solution results, for, when this is brought into filters, a clear, thin fluid passes through the paper from which, by adding acid, only an insignificant precipitate can be obtained, while a clear and very viscid fluid, containing almost all the ovomucin, remains upon the paper.

We have made, page 349, two preparations of ovomucin which had the following composition:

OVOMUCIN.

	A.1.a.	A.1.b.
Carbon	50.69	50.95
Hydrogen	6.71	6.85
Nitrogen	14.49	14.82
Sulphur	2.28	1.94
Oxygen	25.83	25.44
	100.00	100.00

Ovalbumin is the chief constituent of egg white, 50 p. c of its proteids having been obtained in this investigation in the form of perfectly crystallized preparations of this substance, while a large proportion of the remaining proteid matter also consisted of this albumin.

Heat coagulum of ovalbumin. Solutions in pure water, containing 2.5 p. c. of pure ovalbumin, become turbid at 60°, and at 64° yield a flocculent coagulum.

When 10 p. c. of sodium chloride is added to these solutions the temperature of coagulation becomes higher, turbidity developing at 69°, and flocks at 70°.*

When its solution is evaporated to dryness below 50°, and the ovalbumin redissolved in water or in brine, a small amount of substance coagulating at the lower temperature appears to be formed. Thus, sodium chloride solutions containing 2.5 p. c. of B.1, B.2, or C.1, before these substances had been separated by evaporation at 50°, remained absolutely clear until heated to 68° or 69°, while similar solutions, made by dissolving the dried substance, became turbid at 59° and yielded flocks in small quantity at 63°.

Preparations of ovalbumin obtained by evaporating their solutions in pure water to dryness below 50°, do not completely redissolve when treated with water.

Solutions of some preparations thus made, become very rapidly turbid when filtered, and gradually deposit a not inconsiderable quantity of insoluble matter. The amount of insoluble matter in all of our preparations was so small, that we have been unable to learn its nature, but in one case we obtained 0.72 grams from 15 grams of a preparation containing a larger proportion than any we had seen before. This insoluble substance, which contained 15.65 p. c. N, and 1.8 p. c. S, was probably a mechanical coagulum, as it tended to separate at points of contact between the surface of the albumin solution and the vessel containing it. Sodium chloride added to the solution in sufficient quantity diminishes the amount, or prevents its formation. See Hopkins, Jour. of Physiology, **25**, 324.

It has been stated by Hammarsten that with a constant amount

* Stärke (Pflüger's Archiv **12**, 18) notes this effect of sodium chloride on the coagulation of the albumin.

of salt the temperature of coagulation changes with variable amounts of albumin in solution.

We, accordingly, prepared solutions of the dialyzed, but not dried, albumin which contained 5, 2.5 and 1.0 p. c. of ovalbumin and also similar solutions containing in addition 10 p. c of sodium chloride. These, when heated very slowly in a large water bath, coagulated as follows:

		Water	10 p. c. Salt Sol.
5 p. c. albumin	Turbidity	59°	68°
	Flocks	64°	71°
2.5 p. c.	Turbidity	60°	69°
	Flocks	64°	71°
1.0 p. c.	Turbidity	61°	69°
	Flocks	67°	71°
0.5 p. c.	Turbidity	63°	
	Flocks	none even on boiling	

These figures show no difference in temperature of coagulation, for solutions containing from 1.0 to 5.0 p. c. of ovalbumin, together with 10 p. c. of sodium chloride, but solutions of ovalbumin in pure water coagulate at a lower temperature than those containing 10 p. c. of this salt, those containing 5.0 and 2.5 p. c. of albumin, coagulate at one and the same temperature; those containing 1.0 p. c. coagulate somewhat higher, while a solution containing but 0.5 p. c. of albumin yields no flocks even on boiling.

When the proportion of albumin remains constant, while that of the salt increases, the temperature of coagulation rises, as the following table shows:

NaCl	Ovalbumin		
1.0 p. c.	2.5 p. c.	61°	Turbidity
		63°	Flocks
3.0 p. c.	2.5 p. c.	63°	Turbidity
		65°	Flocks
5.0 p. c.	2.5 p. c.	65°	Turbidity
		67°	Flocks
10.0 p. c.	2.5 p. c.	68°	Turbidity
		70°	Flocks

From these results we may state that solutions in water which contain from 2.5 to 5.0 p. c. of pure ovalbumin become turbid on heating to 60°, and yield a flocculent coagulum at 64°,

while those containing, in addition, 10 p. c. of sodium chloride become turbid at 68°, and flocculent at 70°.

In the preceding experiments no acid was added to the solution to be coagulated, the acidity of the ovalbumin (1 gram of albumin required 2.0 cc. of $N/_{10}$ alkali for neutralization to phenolphthalein) being sufficient to bring about coagulation.

When the albumin was exactly neutralized to phenolphthalein, by adding potash, the solution remained clear when heated for some time at 100°. When this solution was treated with acid equivalent to the added alkali a large precipitate resulted which did not separate completely until a very slight excess of acid was added. Thus, when 0.5 gram of albumin was dissolved in 19.0 cc. of water, 1.0 cc $N/_{10}$ KOH added, making the solution exactly neutral to phenolphthalein, and the mixture heated for ten minutes in boiling water, no coagulum was produced. When cooled, 1.0 cc. of $N/_{10}$ HCl was added, which gave a precipitate, from which a clear filtrate could not be obtained; with 1.2 cc. however, the precipitation was so complete that the filtrate gave no turbidity with alcohol. When 1 gram of albumin was dissolved in water and 2 cc. of $N/_{10}$ NH_3 solution were added, a quantity just sufficient to neutralize the acid reaction of the albumin, the solution remained clear after heating for some time at 100°. After cooling, on adding $N/_{10}$ HCl, the solution remained clear until nearly enough acid had been added to neutralize the 2 cc. of ammonia, but when the full 2 cc. were added the albumin was so completely precipitated that the solution filtered from the coagulum contained only a trace of protein matter. The solution, thus neutralized, with either potash or ammonia, gave off hydrogen sulphide when heated and acidified.

To six tubes, each containing 0.5 gram of albumin, dissolved in 10 cc. of water, were added respectively 0.2, 0.4, 0.6, 0.8, 1.0 and 1.1 cc. $N/_{10}$ HCl and then water enough to make each up to 20 cc. When these mixtures were heated in boiling water, the one with 0.8 cc. of acid yielded some coagulum, that with 1.0 cc. but a trace, while that with 1.1 cc. remained clear, showing 1 cc. of $N/_{10}$ HCl to be enough to convert 0.5 gram of albumin into a compound not coagulated by heat. The portions with 0.2 and 0.6 cc. were completely, while that with 0.8 cc. was incompletely, coagulated. When 0.5 gram of

albumin was dissolved in 20 cc. of water, containing from 0.5 cc. to 3.0 cc. of $N/_{10}$ acetic acid and heated in a boiling water bath, the albumin was practically completely coagulated; with 5.0 cc. of acetic acid the solution became opalescent at 64°, and formed a firm, transparent jelly at 75°. On heating at 99° with 10 cc. of $N/_{10}$ acetic acid the solution formed a clear, thin jelly.

When solutions in pure water of any of our purest preparations of ovalbumin were heated to boiling for some time the albumin was so incompletely coagulated that a clear filtrate could not be obtained.

Six 2 gram portions of pure ovalbumin, were dissolved, each in 100 cc. of water, and mixed with equal volumes of water, containing 1, 2, 3, 4, 5 and 6 cc. of $N/_{10}$ acetic acid respectively, and the mixtures boiled and poured on filters. The portion with 1 cc. of acid clogged the filter, as the coagulum separated imperfectly, whereas the others yielded clear filtrates. These, when evaporated to dryness, left residues weighing 0.0492, 0.0332, 0.0320, 0.0446, 0.0648 gram respectively.

From this it is seen that with 1 cc. of $N/_{10}$ acetic acid the coagulation is incomplete, while with 3 and 4 cc. the amount of matter remaining in solution is less than with 2 cc. or than with 5 and 6 cc. This dissolved matter, which is very soluble in water, yields a solution decidedly acid to phenolphthalein and to litmus, contains proteid, and reduces Fehling's solution. Since the proportion, in which it is produced, appears to depend upon the quantity of acid added, we are inclined to regard it chiefly as a product of the action of the added acid upon a small part of the albumin, whereby uncoagulable acid compounds are formed in small, but variable proportion.

Specific Rotation. This was determined for solutions of the ovalbumin in pure water, with a Schmidt and Haensch polarimeter, the readings of the sugar scale being converted into degrees of circular polarization by multiplying by 0.346, and the amount of dissolved albumin was ascertained by evaporating and drying the residue at 110°. Preparations B.1, B.2, C.1 and C.2 showed very nearly the same rotation as that found by us in our former work for preparations of pure ovalbumin. These determinations gave the following values for $[\alpha]_D$:

A*.1	−29.31°	B.1	−29.53°
A*.2	−29.40°	B.2	−29.13°
H*.1	−28.60°	C.1	−30.03°
H*.2	−29.81°	C.2	−30.80°

The degree of rotation was found to be the same in sodium chloride solutions as in water, and also to be the same for the albumin in the dialyzed solutions of the crystals, as in solutions of the albumin which had been separated from such solutions by evaporation at 50°.

Since this paper was written we have received the number of the Journal of Physiology issued April 24, 1900, containing a paper on "Pure Albumin," by F. G. Hopkins, in which he gives the rotary power of pure albumin as —30.70°. The remarkable agreement between the rotation of the many fractional crystallizations, obtained by Hopkins, is much closer than between those observed by us, which is probably due to his superior polariscope and to the stronger solutions of the albumin, containing considerable amounts of ammonium sulphate, which he employed. Because solutions rich in pure albumin, when free from salts, are not easily obtained absolutely clear and tend to become turbid, probably from mechanical coagulation, we were generally not able to use solutions so rich in albumin as those employed by Hopkins. The difference of 1.3° between the values of $[\alpha]_D$ found by Hopkins and the writer, is probably chiefly due to the different methods employed for determining albumin in the solution examined. We have shown, page 363, that when ovalbumin is coagulated in the presence of a minimum of acetic acid, about 1.5 p. c. of uncoagulated matter remains in solution. Whether this occurs under the conditions under which Hopkins coagulated his albumin requires further investigation. Hopkins admits that the method employed by us is the more accurate, assuming that all ammonium sulphate can be separated from the albumin solution. We believe that we have accomplished this in view of the great care we have taken to detect the presence of sulphates in our albumin preparations and feel quite sure that we have not overlooked a quantity of ammonium sulphate sufficient to have caused a difference of 4 p. c. of the observed rotation.

* These are preparations of the old series formerly described, and the two first are *not* parts of fraction A of the present series.

Elementary Composition. In the following table we give the analyses of our four purest preparations of ovalbumin, and also analyses of two preparations made by Hofmeister's method as described on page 366:

COMPOSITION OF OVALBUMIN.

	B.1.	B.2.	C.1.	C.2.	No. 2.	No. 3.	Average.
Carbon	52.59	52.78	52.75	52.79	52.82	52.78	52.75
Hydrogen	7.10	7.09	7.31	7.00	7.03	7.07	7.10
Nitrogen	15.55	15.57	15.50	15.60	15.32	15.53	15.51
Sulphur	1.613	1.619	1.613	1.634	1.590	1.651	1.620
Phosphorus	0.126	0.127	0.131	0.126	0.123	0.112	0.122
Oxygen	23.021	22.814	22.696	22.850	23.117	22.857	22.898
	100.000	100.000	100.000	100.000	100.000	100.000	100.000

ANALYTICAL METHODS.

Carbon and hydrogen were determined by using an open tube with copper oxide, lead chromate and metallic copper, and finishing the combustion in oxygen.

Nitrogen was determined by Dumas' method, the air being removed by a Sprengel pump, the tube then filled with carbonic acid set free by heating sodium bicarbonate at the front end again, emptied by the pump and this process repeated. In this way all the air was removed and no fixed gas was driven off on heating the reagents. Nitrogen was also determined by the Kjeldahl method and results in close accord with those of Dumas' method were obtained.

Sulphur was determined by fusing about one gram of the substance with sodium hydrate and peroxide over an alcohol lamp. The reagents were proved to be free from sulphur.

Phosphorus was determined by fusing about one gram of the substance with sodium peroxide, dissolving the fusion in nitric acid, precipitating with molybdic solution and weighing as magnesium pyrophosphate.

The figures given in the above table agree well with those of others who have prepared and analyzed ovalbumin with especial care, as may be seen in the following table:

COMPOSITION OF OVALBUMIN.

	C.	H.	N.	S.	P.	O.	
Hammarsten	52.25	6.90	15.25	1.64		23.69	uncoag.
Chittenden & Bolton	52.33	6.98	15.89	1.83		22.97	"
" "	52 33	6.98	15.84	1.81		23.04	coag.
Bondzinski & Zoja	52.39	7.11	15.39	1.66		23.45	"
Osborne & Campbell	52.75	7.10	15.51	1.62,	0.12	22.90	
Hopkins	52.75	7.12	15.43	1.57			

There would be no longer any question about the composition of ovalbumin, were it not for Hofmeister's analysis of a single preparation (Zeit. f. physiol. Chem. **16,** 187), and the recent assertion of Schulz (Ibid. **29,** 86), that on crystallizing by the "acid process" a hydrate of Hofmeister's egg albumin is formed. This we have shown in our former paper to be untrue, for we there gave the results obtained by analyzing a preparation made exactly according to Hofmeister's method, which agreed quite well with the analyses of all our other preparations made by the acid method of Hopkins.

That there should be no question as to the composition of crystallized ovalbumin made according to Hofmeister's method we made preparation, No. **2,** recrystallized six times and coagulated by alcohol, No. **3,** by recrystallizing four times, pressing the crystals on filter paper, dissolving them in water, dialyzing the solution perfectly free from sulphate and evaporating the filtered solution at 50° to dryness.

Dried at 110° these preparations were found to have the following composition:

COMPOSITION OF OVALBUMIN CRYSTALLIZED BY HOFMEISTER'S METHOD.

	No. 2	No. 3	Average of the Analyses given on page 365
Carbon	52.82	52.78	52.75
Hydrogen	7.03	7.07	7.10
Nitrogen	15.32	15.53	15.51
Sulphur	1.590	1.651	1.62
Phosphorus	0.123	0.112	0.12
Oxygen	23.117	22.857	22.90
	100.000	100.000	100.00

These analyses are in almost exact agreement with the average given in the preceding table, and fail to confirm Hofmeister's figures for sulphur, or the conclusions drawn by him and by Schulz respecting the relation of the crystallized albumin to that heretofore obtained by other methods. The percentage of carbon found by us falls midway between that given by Hofmeister and the average of that given by the other investigators, with the exception of Hopkins. The very close agreement in composition between all the many fractions, having a constant rotatory power, analyzed by Hopkins and by ourselves, leaves little doubt as to the true elementary composition of crystallized

ovalbumin, especially in view of the close agreement of these analyses with those of Hammarsten and of Bondzynski and Zoja.

In view of the statements recently made by Schulz concerning the proportion of sulphur in ovalbumin (Zeit. f. physiol. Chem. **25**, 16, Ibid, **29**, 86), we used the very greatest care in determining this element. Our solutions of albumin were not only dialyzed until they gave no reaction with barium chloride, but until no sulphate could be detected in the water outside of the dialyzer, even after concentration. That our higher figures for sulphur are not due to ammonium sulphate, which could not be separated from the albumin by dialysis, is disproved, not only by the close agreement between our many analyses, but also by the fact that we obtained exactly the same figures from preparations free from conalbumin and ovomucoid, made by coagulating their dilute solutions at 70°-95°. Thus, we found in D.3.2 1.61, in F.2.1 1.64, in F.3.2 1.61, and in E.3.a 1.63 p. c. We have no doubt that these figures very closely represent the true proportion of sulphur contained in the ovalbumin, especially as they agree with the figures which Hammarsten obtained (Zeit. f. physiol. Chem. **9**, 304), by four different methods, namely: 1.67, 1.67, 1.62 and 1.58 and also with those of Bondzynski and Zoja. The results obtained by Hopkins, (Jour. of Physiology **25**, 306) which have come to our notice since this paper was written, leave no doubt whatever that the true proportion of sulphur is very close to 1.60 p. c., Hopkins finding an average of 1.57 p. c., while we find 1.62 p. c., the slight difference between our results being doubtless due to slight differences in our methods of operation.

It is to be noted that we have found a small but uniform quantity of *phosphorus* in all our preparations of crystallized albumin. In Table I, page 354, it is seen that the four crystallized preparations, B.1, B.2, C.1 and C.2 all contained 0.12 p. c. of phosphorus, whereas all the other non-crystalline preparations contained less; the amount diminishing as the proportion of ovalbumin diminished in the successive fractions. In Table III, page 358, it appears that D.3.1, consisting of conalbumin, contained but 0.01 p. c., whereas D.3.2, consisting of coagulated ovalbumin, contained 0.11 p. c., and D.3.3, consisting of ovomucoid, contained but a trace.

In our earlier series of preparations, this phosphorus was found in the ash, as calcium phosphate; in our present series, only a part of it was present in the ash, in which it occurred as sodium or potassium metaphosphate.

As our former series of preparations were dialyzed in river water containing calcium bicarbonate and our later series in distilled water, it seems highly probable that this phosphorus belongs to an acid united with the crystallized albumin in the same manner as the writer has shown that hydrochloric acid unites with edestin to form crystalline compounds (Jour. Am. Chem. Soc. **21**, 486).

As to the nature of this phosphorized acid we have learned nothing, owing to the small proportion in which it is present.

The carbohydrate split from the ovalbumin by boiling with acids.

These purest preparations of ovalbumin, which we have shown to have a constant specific rotation, the same composition and the same temperature of coagulation, when boiled with acids, all give solutions which yield considerable quantities of crystalline precipitates with phenylhydrazine.

When boiled with 3 p. c. hydrochloric acid for thirty minutes, the solution obtained reduces Fehling's solution, but fails to do so after boiling for three hours. The addition of Fehling's reagent to such solutions causes an intense biuret reaction, but no reduction of the copper salt takes place, even after adding considerable quantities of glucose. Evidently, by continued boiling, some substance is produced which prevents the reduction of the Fehling's solution. Blumenthal and Mayer (Ber. **32**, 274), state that after long boiling this reduction is not so easily detected as after boiling for a short time.

Ten grams of each of the four preparations, B.1, B.2, C.1 and C.2, were boiled with 200 cc. of 9 p. c. sulphuric acid for three hours and the solutions neutralized to litmus with baryta. The soluble matter was filtered out, washed with water, and filtrate and washings were evaporated to a volume of 100 cc. To this solution 10 grams of sodium acetate were added and 5 cc. of a mixture of equal volumes of phenylhydrazine and 99 p. c. acetic acid, and the whole heated for three hours in boiling water. After standing over night, the crystalline precipitates

were filtered off and washed rapidly with water and then with absolute alcohol, which removed a considerable quantity of deep red colored, amorphous substance. The washed precipitates were then dried at 110° and weighed.

In order to learn the effect of the presence of ovomucoid, upon this precipitation with phenylhydrazine, 10 grams of G.4, which had a specific rotation of 39° 22′, and contained much ovomucoid, were treated in the same manner as these albumin preparations and at the same time with them.

For comparison, 100 cc. of a solution containing 1 gram of glucose were treated with phenylhydrazine under the same conditions. The filtrate from each phenylhydrazine precipitate was further treated with 5 cc. of phenylhydrazine and 10 grams of sodium acetate and a second precipitate obtained. From the filtrates from the second precipitations no more could be separated by further additions of phenylhydrazine. The weight of each precipitate dried at 110°, is given in the following table:

	B.1.	B.2.	C.1.	C.2.	G.4.	Glucose
1st	0.2019 grm.	0.1327 grm.	0.1831 grm.	0.0902 grm.	0.2175 grm.	0.3098 grm.
2nd	0.1030 "	0.1027 "	0.0980 "	0.0281 "	0.2684 "	0.3187 "
	0.3049 grm.	0.2354 grm.	0.2711 grm.	0.1183 grm.	0.4859 grm.	0.6285 grm.

Since from C.2 we got so much less of this substance than from the others, we repeated this experiment, using for the first precipitation 10 cc. of the phenylhydrazine-acetic acid mixture and 20 grams of sodium acetate. In this way we got

	C.2.
1st	0.2787
2nd	0.0894
	0.3681

The crystals of the osazone obtained from the albumin consisted of feathery sprays and always appeared distinctly different from the aggregates of needles yielded by glucose. Two different preparations of the phenylhydrazine compound were separately recrystallized by dissolving in boiling absolute alcohol, adding water, boiling until most of the alcohol had been expelled and then allowing the solution to cool slowly until the sub-

stance separated in beautiful yellow crystals of the same form as the original precipitate. These melted at 187° and 189°.

The amount of this osazone indicates that a considerable quantity of carbohydrate is split from our albumin preparations by boiling with acids. The quantity of osazone which we obtained from our preparations varied from one-third to one-half of that given by 1 gram of glucose under like conditions, and if the compound from the albumin is precipitated in the same proportion as the glucosazone we may infer that the albumin yields on hydrolysis from 3 to 5 p. c. of carbohydrate. The amount of osazone which we have actually obtained corresponds to from 2 to 2.5 p. c. of carbohydrate calculated as glucose. Hofmeister (Zeit. f. physiol. Chem. **24,** 170) obtained from 1 gram of ovalbumin 0.13 gram of osazone, from which he infers the presence of 15 p. c. of carbohydrate.

Does this carbohydrate come from the ovalbumin or from a residue of ovomucoid which we have not separated by our fractional crystallizations? Seemann (Archiv. f. Verdaungskrankheit **4,** 275) obtained a copper oxide reduction from ovomucoid corresponding to 34.9 p. c. of glucose. If this proportion is correct, we must have at least 6 p. c. of ovomucoid in our albumin preparations, to account for the minimum yield of osazone, corresponding to 2 p. c. of carbohydrate. This is probably the least quantity of ovomucoid which could yield this quantity of osazone. From the incompleteness of precipitation of osazone, it is probable that the quantity of ovomucoid would have to be more than twice as great to yield the quantity of osazone found. From G.4, which had a specific rotation of 39° 22′, we obtained nearly twice as much osazone as from the ovalbumin, due unquestionably to the presence of ovomucoid in this preparation. If this increased yield of osazone is attended by an increase of 10° in the rotation, an admixture of ovomucoid sufficient to yield such quantities of osazone would manifest itself by variations in the rotation of these albumin preparations, it being improbable that so much ovomucoid was admixed in uniform proportion in the successive crystallized precipitates. We have shown on page 363, that the preparations of ovalbumin when coagulated by heat, left in solution a small quantity of uncoagulable matter amounting to about 1.6 p. c. of the albumin, the nature of which we have been unable to discover, owing to its small quantity. It may be ovomucoid, since it contains

proteid matter and yields a copper reducing body on boiling with acids, but in general appearance and manner of dissolving it does not behave like ovomucoid. As already stated on page 364, we think it more probable that this substance is a product of the action of acetic acid, whereby a small quantity of uncoagulable acid compounds of the albumin is formed. Hydrochloric acid, added in the same proportion as acetic acid, converts, in the absence of soluble salts, nearly all of the albumin into such uncoagulable compounds. A somewhat greater quantity of acetic acid does the same, entirely preventing coagulation. We therefore feel almost certain that the carbohydrate does not originate in admixed ovomucoid, but is derived from the substance constituting the crystallized ovalbumin.

This belief is strengthened by the fact that, so far as we know, all but two of the several investigators who have thus examined coagulated egg albumin, have found evidence of the presence of considerable quantities of carbohydrates among its hydrolytic decomposition products, although most of them have endeavored to separate every trace of ovomucoid. Spencer (Zeit. f. physiol. Chem. **24**, 354), who failed to find carbohydrate, boiled his coagulated albumin for several hours with weak potash and then for thirty minutes with 10 p. c. potash, a procedure which might lead to the destruction of carbohydrate. Moerner (Centralbl. f. Physiol. **7**), who also found no carbohydrate, gives no account of the method he used in preparing the ovalbumin.

Hammarsten regards crystallized ovalbumin as a glycoproteid and considers the carbohydrate group to be a constituent of a non-proteid substance combined with the protein substance proper.

This is certainly true of the nucleoproteid of the pancreas from which Bang obtained guanylic acid, which on hydrolysis yielded about 30 p. c. of carbohydrate. The mucins also appear to be compounds of protein matter with sugar-yielding substances.

We have stated our belief that crystallized ovalbumin is a compound of some acid with protein substance and consider it quite probable that this acid contains the carbohydrate group.

We have been unable to obtain any evidence of carbohydrate in edestin, the crystallized globulin of hemp-seed, nor, according to Hammarsten, can a carbohydrate be split from casein, vitellin,

myosin and fibrinogen. This subject requires further careful study before a definite conclusion can be reached. At present the preponderance of evidence indicates that the carbohydrate is not derived from the protein molecule, but from substances combined with the protein as it is obtained from the tissues or secretions.

Conalbumin. Our fractions of the proteids of egg white, obtained after separating the crystallized fractions, all have a higher rotation and sulphur content and a lower temperature of coagulation than ovalbumin, as is shown in Table I. In Table III we showed that these fractions could be separated into two products by heating their solutions to 65°, filtering off the coagulum, and then heating the filtrate to 90°. In the filtrate from this latter coagulum a substance remained which was not coagulated by boiling.

The body coagulating at the lower temperature we designate *conalbumin,* on account of its close relation in properties and composition to ovalbumin. What this relation may be, we have not determined. Conalbumin and ovalbumin may be different compounds of the same protein, or the former may be a derivative of the latter involving a molecular change.

Composition of Coagulated Conalbumin.

	D.3.1.		F.3.1.		K.3.1.		Average.
	I.	II.	I.	II.	I.	II.	
Carbon	52.17	52.20			52.47	52.14	52.25
Hydrogen	6.98	6.70			7.02	7.07	6.99
Nitrogen	16.04	16.16	16.03	16.15	16.16		16.11
Sulphur	1.67		1.73		1.71		1.70
Oxygen	23.14				22.64		22.95
	100 00				100.00		100.00

These figures show very little difference in composition between ovalbumin and conalbumin, the carbon being about 0.5 p. c. lower, the nitrogen about 0.53 p. c. and the sulphur 0.08 p. c. higher.

It is possible that the higher sulphur is due to a little ovomucoid carried down with the coagulum, but this is hardly probable, as the ovalbumin coagulated in the filtrates from these preparations contained 1.61 p. c. of sulphur, which is exactly

the quantity found in the most thoroughly purified preparations of ovalbumin.

Temperature of coagulation. When a solution of conalbumin is heated sufficiently, a finely divided flocculent coagulum separates which is very difficult from the dense masses that form in a similar solution of ovalbumin. As we could not separate the conalbumin from the other associated proteids except by coagulation, the temperature of coagulation of this albumin could not be determined under definite conditions. The temperature at which this substance begins to coagulate is influenced by the proportion of salts present. From a solution containing 10 p. c. of sodium chloride it separates at a lower temperature than from solutions in pure water. From the former solutions it apparently separated completely below 60°, whereas from the latter it is impossible to separate it from the ovalbumin because the latter begins to coagulate before the separation of the conalbumin is complete.

From solutions containing 10 p. c. of sodium chloride the preparations D.3.1 and K.3.1 separated below 60°, the solutions becoming turbid at about 55°. When 2.5 p. c. of K.3, D.3 and F.3 were each dissolved in 10 p. c. brine their solutions became turbid at 57°, 52° and 58°, and flocks separated at 58°, 55° and 59° respectively.

Specific rotation. This we were unable to determine directly, but indirectly the following results were obtained. Of F.1, 1.5 grams were dissolved in 10 p. c. brine, the solution heated to 65°, and the coagulum filtered out and washed. The filtrate was heated to 98° and the coagulum also filtered out and washed. The nitrogen was then determined in each coagulum and in the final filtrate, and the proportion of conalbumin, calculated on the dry preparation, was found to be 25.0 p. c.; of ovalbumin 62.7 p. c.; and of ovomucoid 12.2 p. c. Subtracting the amount of rotation due to the sums of the two latter from the total rotation of F.1, we found the amount of rotation caused by the 25 p. c. of conalbumin, which for 100 p. c. was equal to $[\alpha]_D$ —39°.

In the same way we found F.3 to contain 36.6 p. c. of conalbumin, 39.7 p. c. of ovalbumin and 23.7 p. c. of ovomucoid, from which we calculated for the conalbumin $[\alpha]_D$ —36°. F.2.a.

contained 30.9 p. c. conalbumin, 48.9 p. c. ovalbumin and 20.4 p. c. ovomucoid, so that in this preparation we found $[\alpha]_D$ equal to —36° 21′.

Of course such determinations cannot be accepted as final, but they are sufficiently accurate to show that conalbumin has a different specific rotation from ovalbumin and is therefore a different substance. This conalbumin appears to be identical with albumin II, described by Panormoff (Chem. Centrabl. 1898, **11**, 487), but so far as we can infer from this abstract of his original paper (Jour. russ, phys. Chem. Ges. **30**, 302), the substance which he describes under this designation corresponds very closely with our fractions C.3, D.1, D.2 and D.3, whose mean rotation and other properties are the same as those given for albumin II.

These fractions we have shown to be mixtures of ovalbumin, conalbumin and ovomucoid.

Ovomucoid. After separating all the proteids coagulable by heat, Neumeister (Zeit. f. Biol. N. F. **9**, 369, 1890), found in the white of eggs a substance which he called pseudopeptone. Later Mörner (Zeit. f. physiol. Chem. **18**, 525, 1893), showed this to be a glycoproteid and named it ovomucoid, under which name it is now generally known.

In Table I it is to be noticed that all the fractions following those of the crystallized ovalbumin show an increasing value for $[\alpha]_D$ and proportional thereto an increasingly greater content of sulphur. This is chiefly due to ovomucoid associated with these fractions. In connection with the detection of sugar in the albumin molecule, it is important to recognize the difficulty with which ovomucoid can be separated from ovalbumin by fractional precipitation with ammonium sulphate.

As we have just shown, fraction F.1 contained 12.2 p. c., F.3 23.7 p. c. and F.2.a. 20.4 p. c. of ovomucoid. These fractions were obtained from those immediately following the separation of the crystalline ovalbumin, and F.1 was precipitated by simply adding an equal volume of saturated ammonium sulphate solution to the solution of these fractions.

We have obtained two preparations of ovomucoid in sufficient quantity for analysis and have found them, when dried at 110°

to have the following composition, which agrees with that given by Zanetti* and by Mörner.†

COMPOSITION OF OVOMUCOID.

	E.4	D.3.3	Zanetti*		Morner†
Carbon	49.02	48.90	48.94	48.75	
Hydrogen	6.45	6.61	6.94	6.90	
Nitrogen	12.71	12.16	12.46		12.65
Sulphur	2.38	2.34	2.22		2.20
Oxygen	29.44	29.99	29.44		
	100.00	100.00	100.00		

The specific rotation was found to be E.4, —61° 38′; D.3.3 —61° 10′; F.3.3 —61° 20′; K.3.3 —61° 30′.

* Ann. di Chim. e Farmac No. 12, 1897.

† Zeit. f physiol. Chem. 18, 525.

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CORRECTIONS.

Page 1. First line, for 1898 read 1899.

Page 7. In alphabetical list, after Dennis, read E. C.

Page 11. Second line after Tucker's, read Special.

Page 13. First line under ANALYSES OF FERTILIZERS for four hundred and fifty-nine, read four hundred and sixty.

Page 19. First line of last paragraph, for 109 read 117.

Page 20. Second line from top, for 107 read 115.

Page 21. In the Summary for 459 read 460.

Page 40. Last line, after Quinnipiac Co. for Hartford read Boston.

Page 47. Ninth line, for Fairfield's, read Fairchild's.

Page 55. Analysis of the National Fertilizer Co's Complete Fertilizer, last column, the guaranteed potash is 6 per cent. and not 10 per cent.

Page 87. Sixth line from the top, for 91 read 92 ; tenth line from top, for 14.1 read 13.1.

Page 156. Third line from bottom, the nitrogen-free extract in Honduras bananas is 83.02, not 87.02, as stated.

Page 163. Fourth line from the bottom, the average percentage of fat in Atlantic gluten meal is 1.9, not 7.9.

Page 208. In the ninth and also in the fifth line from the bottom, insert hard, before raw.

STATE OF CONNECTICUT.

TWELFTH ANNUAL REPORT

—OF THE—

STORRS

AGRICULTURAL EXPERIMENT STATION,

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The Station is located at Mansfield (P. O. Storrs), as a department of the Connecticut Agricultural College. The chemical and other more abstract research is carried out at Wesleyan University, Middletown, where the Director may be addressed.

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Report of the Executive Committee.

To His Excellency George E. Lounsbury,

Governor of Connecticut:

In accordance with the resolution of the General Assembly concerning the congressional appropriations to the Agricultural Experiment Stations, and an Act of the General Assembly approved March 19, 1895, relating to the publication of the Reports of the Storrs Agricultural Experiment Station, we have the honor to present herewith the Twelfth Annual Report of that Station, namely, that for the year 1899.

The accompanying report of the Treasurer gives the details of receipts and expenditures. We refer you to the report of the Director and his associates for a statement of the work accomplished during the past year. We are confident that the funds have been wisely expended, and that the work accomplished is such as will result in great benefit to our agricultural and other interests.

Respectfully submitted,

T. S. GOLD,
W. E. SIMONDS,
G. W. FLINT,
Executive Committee.

Report of the Treasurer

For the Fiscal Year Ending June 30, 1899.

The following summary of receipts and expenditures, made out in accordance with the form recommended by the United States Department of Agriculture, includes, first, the Government appropriation of $7,500, and, secondly, the annual appropriation of $1,800 made by the State of Connecticut, together with various supplemental receipts. These accounts have been duly audited according to law, as is shown by the Auditors' certificates, copies of which are appended.

GOVERNMENT APPROPRIATION—RECEIPTS AND EXPENDITURES.

RECEIPTS.

United States Treasury,	$7,500 00

EXPENDITURES.

Salaries,	$3,199 76
Labor,	1,088 94
Publications,	326 08
Postage and stationery,	368 69
Freight and express,	85 14
Heat, light, and water,	458 94
Chemical supplies,	154 69
Seeds, plants, and sundry supplies,	154 37
Feeding stuffs,	264 64
Tools, implements, and machinery,	1 60
Furniture and fixtures,	543 15
Scientific apparatus,	516 07
Live stock,	40 44
Traveling expenses,	99 32
Contingent expenses,	10 00
Building and repairs,	188 17
Total,	$7,500 00

AUDITORS' CERTIFICATE.

This certifies that we have this day examined the accounts of Henry C. Miles, Treasurer of the Storrs College Experiment Station, for the fiscal year ending June 30, 1899, and have compared said accounts with the vouchers and find the same to be correct, showing receipts and expenditures both amounting to the equal sum of ($7,500) seven thousand five hundred dollars.

THEODORE S. GOLD,
W. E. SIMONDS,
Auditors of Connecticut Agricultural College.

HARTFORD, June 30, 1899.

STATE APPROPRIATION AND SUPPLEMENTAL RECEIPTS— RECEIPTS AND EXPENDITURES.

RECEIPTS.

State of Connecticut,	$1,800 00
Miscellaneous receipts,	1,174 32
Total,	$2,974 32

EXPENDITURES.

Salaries,	$1,399 62
Labor,	375 10
Publications,	17 67
Postage and stationery,	51 60
Freight and express,	17 56
Heat, light, and water, including electric power,	184 09
Chemical supplies,	168 05
Bacteriological investigations,	500 00
Seeds, plants, and sundry supplies,	34 48
Furniture and fixtures,	51 50
Scientific apparatus,	170 43
Live stock,	35
Traveling expenses,	3 87
Total,	$2,974 32

HENRY C. MILES, *Treasurer.*

AUDITORS' CERTIFICATES.

This certifies that we have this day examined the accounts of Henry C. Miles, Treasurer of the Storrs College Experiment Station, "Investigation of food economy," for the fiscal year ending June 30, 1899, and have compared the said accounts with the vouchers and find the same to be correct, showing receipts and expenditures both amounting to the equal sum of ($1,800) eighteen hundred dollars.

THEODORE S. GOLD,
W. E. SIMONDS,
Auditors of Connecticut Agricultural College.

HARTFORD, June 30, 1899.

This certifies that we have examined this day the miscellaneous accounts of Henry C. Miles, Treasurer of the Storrs College Experiment Station for the fiscal year ending June 30, 1899, and have compared said accounts with the vouchers and find the same to be correct, showing receipts and expenditures both amounting to the equal sum of ($1,174.32) eleven hundred and seventy-four 32-100 dollars.

THEODORE S. GOLD,
W. E. SIMONDS,
Auditors of Connecticut Agricultural College.

HARTFORD, June 30, 1899.

Report of the Director for the Year 1899.

During the year 1899 the work of the Station has been along lines similar to those followed for several years past. It includes experiments on the effects of fertilizers upon the growth and composition of plants, studies of dairy bacteriology and of bovine tuberculosis, and investigations upon the food and nutrition of man. The digestion experiments with sheep which have been carried on for a number of years have been discontinued. Studies of milk production by cows, carried out with the college and private herds, by Prof. C. L. Beach, of the Connecticut Agricultural College, were reported in Bulletin 20 of the Station.

METEOROLOGICAL OBSERVATIONS.

The usual observations of temperature, barometric pressure, wind velocity, humidity and precipitation have been made at Storrs. In addition, records of rainfall during the growing season have been made in other places by farmers who have coöperated with the Station.

EXPERIMENTS ON THE EFFECT OF FERTILIZERS UPON THE YIELD AND THE COMPOSITION OF CROPS.

Plot experiments.—From the time of its establishment the Station has been engaged in experiments for testing the effects of fertilizers upon the amounts and composition of the crops produced. These have been made principally with grasses, grains, and legumes. Several series have been carried out continuously on the same land year after year. The larger number have been made in the field, but some, with grasses, have been conducted on a smaller scale in the experimental garden. The results have been reported from year to year. During the past year these experiments have been made with corn, cow peas, soy beans, and various species of grasses, in both the field and in the garden.

In the Report of the Station for 1898 a detailed account was given of the results of these experiments, especially in their bearing upon the effect of nitrogenous fertilizers. It has long been known that nitrogenous fertilizers increase the yield of grasses and cereals, but have comparatively little effect upon the yield of legumes. The most important result of these experiments is to show that the nitrogenous fertilizers increase also the proportion of nitrogen in the grasses and cereals, although they have but very little effect upon the composition of the legumes. This principle, which has hitherto been but little understood, is of much importance to the farmer.

Pot experiments.—Experiments for the study of the effects of nitrogenous fertilizers upon the proportion of nitrogen in the plants have been made on a small scale in such a way that moisture and other external influences might be more completely under control. In these experiments the plants are grown in large pots by the use of the same kinds of nitrogenous and other fertilizers as are used in the plot experiments, the total produce being weighed and taken for analysis. The details of these experiments are withheld from publication until more data shall have accumulated.

DAIRY BACTERIOLOGY.

For a considerable number of years Prof. Conn and his assistants have carried on investigations upon dairy bacteriology. One of the special objects of the latter work has been to get information concerning the species of bacteria that are more common in Connecticut dairies, their sources, and especially their effects upon milk and cream and upon butter made from the cream ripened under their influence. For several years past Prof. Conn has been assisted in this work by Mr. W. M. Esten, who has devoted much time to these investigations and has made an especial study of the organism *B. acidi lactici*, which is the most common cause of the souring of milk, and which he isolated in 1896. These investigations have been continued during the past year, special attention being devoted, as previously, to the ripening of cream and to the bacteria concerned in the process.

The results of the investigations by Prof. Conn and his associates have been published year by year in the Reports and

Bulletins of the Station. With the progress of the inquiries and the increase in the number of species isolated, it has been found necessary to devise a method of classification in order to make it easier to determine whether any particular organism which may be isolated is identical with some one already found or is a new species. In the present Report Prof. Conn discusses a method which he has developed for use in his own laboratory, and classifies according to it the species which he has isolated there. This method of classification has proved so useful that Prof. Conn has given it herewith in considerable detail, in the hope that it may prove useful in establishing a means by which American bacteriologists can compare their results.

BOVINE TUBERCULOSIS.

The experiments with tuberculous cows and with their milk for feeding calves, which were begun in 1896, have been continued during the past year. The present Report gives a statement concerning the condition of the cows and details of the experiments for the year 1899. These studies are being continued.

ANALYSIS OF FOODS, FEEDING STUFFS, ETC.

In connection with the inquiries of the Station a large number of chemical analyses are required. During the past year these have included analyses of samples of crops grown in the tests with fertilizers, and of foods and other materials used in the metabolism experiments with man.

In addition to the chemical analyses of the various foods, feeding stuffs, etc., the heats of combustion of these materials, which are used in determining their fuel values, have been determined by the use of the bomb calorimeter.

FOOD AND NUTRITION OF MAN.

Investigations upon human nutrition have been carried on during the past year as usual. These are conducted in coöperation with the U. S. Department of Agriculture, which defrays a considerable share of the expense. In this way much more extensive and accurate inquiries are made than would otherwise be possible. The lines of research during the past year have been chiefly metabolism experiments with a

man in the respiration calorimeter, studies of the digestibility of mixed diets, and studies of actual dietaries. Summaries of the work done and statements of the most important results obtained and conclusions reached, have been given in publications of the Station for the past few years and may be found in this Report. The full details, which are too voluminous for publication by the Station, and are of such general interest as to call for wider distribution than it could give them, are published by the Department of Agriculture. These investigations form a part of a more general inquiry which is authorized by Congress and is carried out in different parts of the country under the authority of the Secretary of Agriculture, who has placed them in charge of the Director of this Station.

Dietary studies.—The studies of actual food consumption of groups of people and of individuals form as in the past one of the important lines of inquiry of the Station. During the past eight years the results of over 350 dietary studies in the United States have been reported, the majority of which were conducted by experiment stations and other institutions in coöperation with the U. S. Department of Agriculture as a part of the general inquiry just mentioned. Of these studies about fifty were carried out by this Station. The work of the past year includes the study of the actual food consumption at two of the buildings of the Connecticut Hospital for the Insane during one week, and several dietaries of families and individuals for various periods.

Digestion experiments.—Twelve experiments upon the digestibility of food by man were made during the past year. The results obtained in these and similar investigations elsewhere, together with those obtained from analyses of food materials and from determinations of heats of combustion by use of the bomb calorimeter, have been utilized in deriving the data for the availability and the nutritive value of American food materials which are summarized in one of the articles of this Report.

Metabolism experiments. — Eleven metabolism experiments were carried on during the past year, the details of which will appear in Bulletins of the U. S. Department of Agriculture. Some of the results of the work are given in the present Report.

Such research is elaborate, time consuming and costly, but the results are already such as to give great encouragement, and it is my belief that no work which the Station has attempted is producing or would produce results so valuable, whether viewed from the standpoint of pure science or that of practical utility, as this and kindred lines of investigation.

Respiration calorimeter.—The metabolism experiments just referred to have been made by the use of the respiration calorimeter. Concerning the nutrition investigations in general and this apparatus in particular, the following statement may not be out of place here. It is taken from Bulletin 80, of the Office of Experiment Stations of the U. S. Department of Agriculture, a volume which was prepared to accompany the exhibit of American Agricultural Experiment Stations at the Paris Exposition of 1900:

"From the scientific standpoint, the most noteworthy feature of these inquiries is found in the researches with the Atwater–Rosa respiration calorimeter, by means of which the study of the application of the laws of the conservation of matter and of energy in the human body are being carried out with a completeness not previously attained. Indications of the value of this apparatus and method of inquiry are already apparent in the fact that an apparatus on the same general plan, but large enough for experiments with domestic animals, is already in process of construction at the Experiment Station of the State College of Pennsylvania, under the direction of Prof. H. P. Armsby, and in coöperation with the Bureau of Animal Industry of this Department. The Prussian Government has provided means for the construction of a similar apparatus for the Institute of Animal Physiology at Bonn, under Prof. Hagemann. An appropriation, under government authorization, has also been made for the construction of a like apparatus in connection with the Institute of Animal Physiology at Budapest, under Professor Tangl."

EXHIBIT OF THE STATION AT THE PARIS EXPOSITION.

By invitation of the Committee of the Association of American Agricultural Colleges and Experiment Stations on a Collective Station Exhibit at the Paris Exhibition, a cabinet of forty-eight cultures of bacteria, isolated from various dairy products, and prepared by Prof. Conn, a bomb calorimeter with all its accessory apparatus, and a model of the respiration calorimeter were contributed to this general Experiment Station exhibit. The selection of these subjects was in accordance with the suggestion of the committee mentioned above,

whose object was to exhibit at Paris such things as would best exemplify the most valuable scientific as well as practical work of the experiment stations of the United States.

PUBLICATIONS.

Two Bulletins have been issued during the past year: Bulletin No. 20, "A Study of Dairy Cows," by Prof. C. L. Beach, of the Connecticut Agricultural College, and Bulletin No. 21, "The Ripening of Cream," by Prof. H. W. Conn. Other Bulletins are now in preparation and will be issued from time to time. These are printed in numbers sufficient to supply the entire mailing list of the Station, whereas the number of Reports issued will be somewhat smaller than in previous years. This change, which it is believed will prove very advantageous, has been made practicable by the Act of the last General Assembly, which permits the publication of the more technical details in the Annual Report for a permanent record and for the especial use of those interested in such matters, while it also provides for the printing of popular Bulletins of a more practical character in larger editions for more general distribution.

W. O. ATWATER,
Director.

CLASSIFICATION OF DAIRY BACTERIA.

BY H. W. CONN.

COLLECTION OF THE BACTERIA.

For the last ten years, in which the work upon dairy bacteriology has been carried on for this Station, I have been gradually collecting from the dairy products of the vicinity a variety of forms of bacteria. These have been obtained from milk and cream and occasionally from butter. During that time a very large number of different cultures have been isolated from these dairy products, and have been studied in the laboratory by bacteriological methods with more or less completeness. Of the many hundreds thus collected, large numbers of course have proved to be duplicates. As fast, however, as it became apparent that any particular form isolated and studied was distinct from those previously characterized, the bacteriological characteristics of the new variety were carefully detailed and the form was entered in a list by number, together with the characteristics as they were determined. In this way there has accumulated a list of over 200 different types of bacteria which have been regarded as more or less distinct from each other. It may be assumed that this list contains probably all of the common species of bacteria which are likely to be found in dairies of this vicinity. Of this long list many of course have been found to be very commonly, some indeed almost universally, present in milk. Others are more uncommon, being found only a few times, and many indeed have been isolated only a single time and must therefore be regarded as purely accidental. It has been found, as would be expected, that the species of bacteria in a sample of milk vary somewhat with the locality from which the milk is obtained, and also with the season of the year in which the examination is made. A few forms of organisms are so widely distributed as to be almost universal, both as to locality and as to season.

Of the bacteria in my list there are quite a number that have not been described with sufficient accuracy to make the description of any considerable value. This is true especially of some

of the earlier varieties that were isolated before the methods of description were sufficiently worked out; and it is also true of some of the later ones which were by accident lost before a complete description was obtained. Moreover, during the period in which these experiments have been going on the methods of bacteriological work and description have been quite materially changed, and it is now considered essential to determine certain characteristics which in early years were not much attended to. The result is that the descriptions given beyond of the different bacteria are of varying value. No one can be more fully aware of the incompleteness of some of these descriptions than myself, and for this reason a considerable number of the bacteria in the list which I have collected will be left out from the following classifications because the descriptions are too incomplete to be of any particular value.

NEED OF CLASSIFICATION OF BACTERIA.

As the list of dairy bacteria in my hands has thus been increased, it has been found more and more necessary that some kind of classification and grouping of these different bacteria should be devised. When the number reaches into the scores it is a matter of very great difficulty to determine whether the new culture isolated from milk is really new or is identical with some of the forms previously studied, and it becomes therefore absolutely necessary that some simple means of grouping the different bacteria should be obtained to make this determination possible. During the past few years I have gradually developed a method of grouping these bacteria which has proved extremely useful in my laboratory and has very greatly simplified the problem of the further study of new varieties isolated.

Inasmuch as it has proved so useful in the determination of the forms found here, I have thought it not unwise definitely to formulate the method of grouping which has been used, and to publish along with it the descriptions of all of the more important of the varieties of bacteria which have been isolated here. There are at the present time a number of American bacteriologists working upon dairy bacteriology, and it is eminently desirable that they should be able to compare their results with each other. As long as the species found by one bacteriologist are described only in private notes, they cannot

of course be compared with those found by another, and the work of the different observers in different parts of the country cannot be brought into relation. It is certainly time that our dairy bacteriologists should begin to compare results. For the purpose of making a beginning in this direction, the following classifications and descriptions of bacteria have been put together and are now published. It is hoped that it may serve to enable the different dairy bacteriologists to compare the species of bacteria in one locality with those in another, and thus may aid in simplifying the problem of the species of dairy bacteria. Hitherto there has been nothing of this sort published in this country, nor indeed in Europe. Isolated descriptions of a few dairy bacteria have been published in one place and another, but no attempt has been made to get together under one list the types of bacteria which are found in dairy products. The water bacteria have been much more carefully studied and classified; and it is clearly a matter of importance that the dairy bacteria should in a similar way be brought under more or less distinct classification. The present list will therefore serve as a start in this direction.

METHOD OF CLASSIFICATION.

No one can be more fully aware of the incompleteness of the following list than I am myself. Strictly anaerobic species I have not yet studied, nor have I as yet made any study of the spore forming species which remain in milk after boiling. Some of the species are imperfectly described. Doubtless some of my species should be divided, and perhaps others that I have regarded as separate will subsequently be united into one. But all pioneer attempts at classifying bacteria must be open to criticism. It is my hope that this classification may be the beginning of a work which shall be slowly perfected, and may be at all events of use as a point of departure for the adoption of better plans in future. If it shall serve as a means of bringing together the work of American dairy bacteriologists its purpose will be accomplished.

Every one who has had anything to do with the descriptions of bacteria has been impressed with the difficulty of following through those given in the ordinary way and comparing them with each other. This is due partly to the great detail which is given in some cases and to the lack of detail in others. In

many of these descriptions nonessential features are given with great detail, and the whole becomes immensely confusing. It has seemed to me that the method adopted by Fuller and Johnson in a recent publication on water bacteria* marks a very decided advance in our method of arranging the characteristics of bacteria. They have devised a scheme whereby all of the important characteristics of a given species of bacteria may be briefly indicated by positive or negative signs, so that, by the proper arrangement of tables, it is possible by the use of a few of these signs to give in a very brief compass all of the important characteristics of the organisms to be described. The advantages of this scheme are manifold. In the first place it avoids the needless confusion of details which is so likely to arise from the verbose descriptions which may be given. In the second place it makes possible a direct comparison of species with each other, and enables one to determine at a glance whether two forms are in agreement so far as regards their chief characteristics. If then further details be given elsewhere, with more careful descriptions, the task of determining whether a new variety is identical with one already described is an easy one. The success of this method as applied to water bacteria has led me to adopt the same in the description and classification of the dairy bacteria, and the tables in the following pages are therefore based upon the same principle as those which have been used by Fuller and Johnson in their classification of water bacteria.

In these tables, however, I have found it necessary to adapt the plan to the descriptions which I have in my possession, and consequently to change the character of the table somewhat. In the study of dairy bacteria certain characteristics have been inevitably regarded as of more importance than others; and in the descriptions of the bacteria which I have been accumulating some factors, particularly those in connection with the action of the bacteria upon milk, have been studied in more detail than would be possible to indicate in the table of Fuller and Johnson. On the other hand, some of the characteristics which they have included in the study of water bacteria have not been determined at all, or only incidentally, in the case of the bacteria studied here. This is to be regretted, since it is eminently desirable that the different

* Jour. of Exp. Med., 1899.

bacteria should be comparable with each other. It is, however, at present unavoidable, because most of these species have not been preserved in culture in the laboratory, and it is now impossible to determine the characteristics which have not hitherto been made out. For these reasons the tables which I have been obliged to make out and to use differ in some details from those of Fuller and Johnson. I have, however, followed them as closely as possible.

SOURCES OF THE SPECIES.

A word as to the sources of the different species of bacteria which are here described. All have been obtained from dairy products. A majority of them have come from cream either from neighboring creameries or from private dairies, some being obtained from ripened cream, others from unripened cream. Some of them have been obtained from milk as delivered in Middletown by milkmen. Some have been obtained from the milk after it has stood in the pantries of private houses. Some of the species have been obtained directly from milk as drawn from the teats of the cow into sterilized vessels, others again from the dust which falls into the milk pails during the milking. Two of these species have been obtained from some samples of special milk which had been sent in cans from Uruguay; and some of the species have been obtained from samples of milk that were sent to Middletown from a large number of States in the Union, ranging from Maine to California. All, however, are strictly dairy organisms, being found in milk or its products.

METHOD OF ISOLATION AND STUDY.

The method of isolation and study requires little description, inasmuch as it has been, in general, that commonly used in bacteriological study. For the isolation of the bacteria from the milk ordinary gelatin has been used. In most of the early years the gelatin was made in the ordinary way, but in recent years it has been found that a much more satisfactory result is obtained if there is added to the gelatin three per cent. of milk sugar. The reason for this is manifest. Milk always contains a considerable portion of milk sugar. Naturally, therefore, it is to be expected that the typical dairy bacteria will grow much more rapidly in gelatin provided with milk sugar. Indeed, some

of the characteristic species are isolated with great difficulty from cream by the use of ordinary gelatin, but are found with the greatest of readiness by the use of sugar gelatin. Practically also it has been found extremely useful to employ for this purpose only gelatin which has been rendered blue with litmus solution, as this makes it possible readily to distinguish the acid organisms from those that do not produce acids. It has been found that one species of bacterium which is par excellence a dairy species, namely *B. acidi lactici*, No. 206, produces in such gelatin a colony which is most readily distinguished from any other species of bacteria, and this of course makes it extremely convenient for use.

After isolation of the bacteria they have been purified by replating in the customary manner, and then inoculated into the ordinary media for the purpose of determining their characteristics, which have been obtained as usual. Special attention, however, has always been given to the effect of the organisms upon milk at ordinary room temperature and at higher temperatures. In many cases also the action of the organisms upon sterilized cream has been determined, and in a considerable number of the cases the influence of the organisms upon the character of the butter obtained from cream ripened by means of them has been made out.

Unfortunately, the use of the fermentation tube has not been adopted so widely as would be desired. In the study of some species the fermentation tube has been used, but in the majority of cases it has not. In the work that is done now it is used in all cases, but in many of the descriptions which have been given in past years this important test was omitted. For this reason the production of gas in glucose bouillon has not been determined in many cases. In determining the characteristics of these bacteria no attempt has been made to determine their action upon nitrites or the production of indol, nor has any attempt to determine pathogenic characteristics been made. These features have not yet been regarded as of significance enough in the study of dairy bacteria for dairy purposes to warrant the time which would be taken in determining them.

GROUPING THE BACTERIA.

In dividing the dairy bacteria into groups I have tried so far as possible to follow the methods already adopted, and have

used as the foundation of my grouping that of Flügge given in the last edition of his *Die Microörganismen*. This grouping, as will be seen below, is based partly upon the power of producing pigment and partly upon morphological data. This arrangement is quite similar to that which has been adopted by Fuller and Johnson, and is easily compared with that which has been adopted by Chester in his valuable study of the classification of bacteria. As I have arranged these groups it results that in some cases there are placed together under one table the two genera which Migula has distinguished as *Bacillus* and *Bacterium*. According to Migula's classification a distinction between these two genera is based upon the formation of spores. The genus *Bacillus* produces spores, while the genus *Bacterium* does not produce spores. By the method of grouping which I have adopted, it has resulted that in groups IV. and VII. both of the genera *Bacillus* and *Bacterium* are included. This confusion, however, is not a serious one, since it involves only a few organisms. The grouping that has been adopted in the following pages is one which I have found to be the easiest to use in laboratory practice. The groups which I have recognized are as follows:

GROUP I. *Fluorescent bacteria.*
II. *All red chromogenic forms.*
III. *All orange chromogenic forms.*
IV. *All lemon yellow chromogenic forms.*
V. *All non-liquefying micrococci not included in II., III., and IV.*
VI. *All liquefying micrococci not included in II., III., and IV.*
VII. *All non-liquefying rods which are not chromogenic. These are mostly of the species Bacterium, but the table includes two of the genus Bacillus.*
VIII. *All liquefying Bacteria without spores.*
IX. *All liquefying Bacilli with spores no larger than the rods.*
X. *All liquefying Bacilli with large spores causing the rods to be swollen at the time of sporulation.*

NAMING THE SPECIES.

In regard to the question of naming the species described, I have been somewhat at a loss as to the best method of procedure. Some of the species which are described are unquestionably entirely new and are very distinctly characterized. Others are very obscure in their diagnostic character, so much so that it has been difficult or impossible to give characters which very clearly define them. In these cases I have been

uncertain whether I was dealing with wholly new species or not. Some of the species described are very abundant and are found very frequently in dairy products, while others are rare, being found only once or twice. In my original laboratory notes each of these species has been entered by number. But it has seemed to me wisest in the following pages to apply names to such species as are clearly distinct and new. I have looked through the literature of systematic bacteria as carefully as possible, and wherever I could do so I have identified the species I have found with those described elsewhere. This, however, has not been possible in a majority of cases. It must be regarded as doubtful whether the identification of species found in milk with those found in water, soil, and air is accurate, and when the attempt is made to identify American species with those of Europe the uncertainty becomes very great. A few well marked species may be thus readily recognized, but for most species we must, in the present condition of bacteriology, recognize that any identifications of American dairy bacteria with bacteria from other sources and localities is very uncertain. For the most part the dairy bacteria must at present be considered by themselves. Where I have been able to class my species with those elsewhere described, the classification has been indicated by applying to the organism here described the name of the species with which it has been identified.

In regard to the rest of the species which cannot be identified with any described species, I have adopted the following plan. Wherever the species in question is an extremely common one or one that is very easily described and recognized from description, I have given it a specific name. In using these names I have in most cases added the word *lactis* for the purpose of indicating the fact that the organism in question is of a species found in milk. In the following pages, therefore, where a new name has been applied to a described organism this indicates either that it is a very abundant dairy organism or that it is one whose characters are so distinct as to indicate clearly that it differs from any other described species, and moreover so distinct that it can easily be recognized from the description. Where the organism in question, however, is found only rarely in dairy products and has characteristics so obscure as to make

it difficult to define it with accuracy, I have simply retained the original number by which this species has been entered in my laboratory notes. It is hoped that further study in future years may enable me to determine more accurately whether the species should be subsequently kept isolated and given specific names or whether they may eventually be merged into some of the other more common types.

METHOD OF TABULATION.

In the use of the tables the following methods have been adopted. At the top of the table in parallel columns are given certain characteristics which are indicated for each organism in the proper column by the sign + or —. The sign + indicates always that the species possesses the characteristic in question, the sign — that it does not possess the characteristic in question. In some places the sign ± has been inserted, which indicates that the characteristic in question is doubtful. For example, under the column headed "Diameter greater than 1μ" the ± means the diameter is practically 1μ. In the column referring to the reaction of milk, the ± sign indicates that the reaction is unchanged or is amphoteric. The other places where the ± sign is used explain themselves. In the use of this table the word bacillus merely refers to the fact that the organism is a rod rather than a coccus, and it does not mean that the organism is a bacillus in the sense of Migula's classification.

The tables when thus filled out give in a brief compass the chief diagnostic characters of the different species of bacteria. But these are not sufficient to give a complete description. There is therefore given in the pages following the table, under the proper numbers and names, such description of diagnostic characters as may be needed, in addition to those inserted in the tables, for the proper diagnosis of the species. By the use of the tables and these descriptions together each species is described as fully as possible from the data which are in my possession. These tables will be found extremely simple to use if one has a species of bacterium which he wishes to identify with those described. My method is as follows: I make a "trial slip" giving the characters included in the tables. Upon this slip I enter the characteristics of the species being studied with the + and — signs in spaces corresponding to

the columns in the tables. Then by moving the trial slip up and down the table it is possible to determine at a glance whether it agrees with any of the described species. If it is found that the characteristics agree practically with those of any species given in these tables, reference to the descriptions following will give further details and will make identification in most cases a simple matter. The whole comparison takes only a very few minutes and is a great saving of time over the old method of comparing long detailed descriptions.

THE CHIEF DAIRY SPECIES.

It is necessary to give here a brief statement concerning the bacteria which are to be regarded as the distinctive dairy organisms of this region. Although the number of species found in dairy products as seen by the following pages is large, the number of those which are found with very great uniformity in dairy products is small. Indeed, as the result of my experiments I have concluded that the dairy organisms of this region are chiefly of four species. Strictly speaking, it is probably more correct to say three groups of closely related bacteria rather than four single species. They are as follows:

The most abundant of our dairy organisms is No. 206, which is the *B. acidi lactici* (Esten). As already mentioned in a previous publication,* it is almost universally found in samples of milk or cream. This appears to be true not only of milk and cream in this region but of milk from a very wide territory. Samples of milk that have been sent us from a large number of States have in almost all cases shown the presence of this organism in abundance. In sour milk it is almost always present. In all samples of ripened cream which we have studied it has been found to be by far the most abundant species. In most samples of ripened cream this No. 206 forms over 75 per cent. of the bacteria present, and sometimes over 90 per cent.

The source of this organism in our milk has been a matter of some little interest, and has been studied by experiment in the last few months. Its almost universal presence in milk, together with the markedly anaerobic character, would seem to indicate that it probably comes from the milk ducts. This

* See Report of this Station for 1896.

conclusion has not been borne out by the direct studies of bacteria in the milk ducts. Our recent experiments seem rather to point to the conclusion that this organism comes from external contaminations. When we have collected samples from large numbers of cows, drawing the milk directly from the teats into sterilized vessels with little or no chance for contamination, it has been found that milk thus obtained only in very rare cases contains the organism No. 206. In the experiments, which now number over 200 and involve 75 well kept cows, there have been only five instances where such milk contained this organism, and the cows concerned in these five cases did not show the same result with a second test. The milk obtained directly from the cows in this way contained many species, commonly including liquefying bacteria, but not this common lactic species. When, however, the milk is drawn from the cow into sterilized vessels with a more widely open mouth, the organism in question has been found in most cases to be present, and becomes abundant in a few hours. This indicates that the *B. acidi lactici* should be regarded as an organism which comes from external contamination, and is not a normal inhabitant of the milk duct. On the other hand, up to the present time I have not succeeded in finding the organism in question present in any considerable numbers in gelatin plates which have been exposed to the air underneath the cow during the milking process. My present belief is that this organism is not a normal inhabitant of the milk duct, but commonly is derived from external sources, and is practically always present in the milk vessels into which the milk is drawn.

Next in abundance to the organism just described is No. 202. This may perhaps be a variety of the last, but it differs from it in being more markedly anaerobic, and in producing a colony in gelatin which is extremely minute and indeed invisible to the naked eye, whereas No. 206 produces a good sized colony. This is also very abundant in nearly all samples of sour milk or cream, although the numbers are much less than those of the last species. This organism I have not been able to find in the milk ducts any more than the last, and I regard it also as being derived from external contamination.

These two species undoubtedly belong together, not only from their morphological similarity and their general likeness

in growth upon various media, but also from their action on milk. They certainly represent a type of dairy organisms common everywhere. Many of the lactic organisms hitherto described by different bacteriologists clearly belong to this type, although slight differences in described characteristics perhaps indicate different varieties. This is true of the *Bacterium acidi lactici* of Günther and Thierfelder, *Bacterium lactis acidi* of Leichmann, *Bacillus XIX.* of Adametz, *Bacillus a.* of v. Freudenreich, *M. acidi laevolacidi* and *B. acidi laevolactici* of Leichmann and several of the types described by Storch. The pure culture used in cream ripening and put on the market by Hansen is a culture of one of this type of lactic organisms, and the same is true of the pure cultures of Witte and Barnekow. All of these organisms agree very closely in general characters and are doubtless closely related. In this region this type, represented by No. 206 and No. 202, is the most abundant milk bacterium, at least in milk obtained in the ordinary manner and allowed to stand for several hours before testing.

The next most important dairy species in this vicinity is No. 208, which I have regarded as identical with *B. lactis aerogenes*. This is found almost universally, although never in very great numbers. The organisms included under this number, however, have shown very wide variations, and it is quite possible that a number of distinct types are here included. At all events, it is quite certain that if all these forms are to be regarded as one species, several quite distinct varieties must be recognized among them. The distinctive characteristics of these species are, (1) the intense acid that the colonies produce in litmus gelatin; (2) the abundance of gas which is developed when they grow in milk sugar bouillon or in milk; (3) the uncertainty as to their power of curdling milk, this occurring commonly at high temperatures though not commonly at room temperatures; and (4) the distinctive odor of sour milk which is found in milk that has been curdled by means of them. *B. acidi lactici*, I. and II., Nos. 206 and 202, although they curdle milk with the production of lactic acid, do not give rise to the typical sour milk odor, and neither of them develop any trace of gas in the milk. I am therefore convinced that the ordinary souring of milk is produced in part by the action of this No. 208, and that typical sour milk, with its tendency to

fragmentation and its sour odor, is never developed unless some of the organisms included in my No. 208 species are present. Ordinary sour milk, according to my observations, is produced by these three organisms, and probably in the spontaneous souring of milk all three are present.

I am convinced that here also the various bacteria which I have included under No. 208 do not represent a single bacterium, but rather a group of allied varieties, and as a group represent a most important dairy organism. In looking through the literature upon dairy bacteria, it appears to me that many of the lactic organisms that have been described by different observers belong to this group. The original *B. acidi lactici* of Hueppe apparently belonged here. Here, too, probably must be placed *Bacterium lactis acidi*, Marpmann, *Bacillus lactis acidi*, Marpmann, *Bacillus acidi lactici*, I. and II., of Grotenfelt, *No. 8* of Eckles, and doubtless several others. In the pure cultures used for cream ripening in European countries, known as the culture of Lorenz, the organisms appear to belong to this same type. The two forms recently isolated from Edam cheese by Leichmann and Bazarewski and called *Bacterium caesi*, I. and II., also belong to this series. It is quite unlikely that these different organisms are the same, although their morphological and cultural characters in general accord. All of these facts indicate that in the species which I have at present called *Bacillus lactis aerogenes* there are grouped together a number of types with great similarity, but with at least different physiological characters.

The third type of bacteria which I have found so abundant as to call it a distinctive dairy bacterium of this region is my *M. lactis varians*, No. 113. This has been sufficiently described elsewhere, and as already mentioned is a very highly variable Micrococcus both as to chromogenic powers and power of liquefying gelatin. This species is common in fresh milk and probably exists in the milk ducts. It is commonly overgrown by the lactic organisms and is less common in old milk. It is by no means universally found and may be only a local species.

Several other species in my list are quite common in milk, but I think that these four must be regarded as the chief dairy bacteria of this region.

CLASSIFICATION OF DAIRY BACTERIA.

TABLE I.

NAME AND NUMBER.	MORPHOLOGY.						CULTURAL FEATURES.																BIOCHEMICAL FEATURES.										
							Nutrient broth tube.			Nutrient agar tube.		Gelatin plate.			Gelatin stab.					Potato tube.							Milk.							
	Bacillus.	Coccus.	Diam. greater than 1 μ.	Motile.	Uniting in chains.	Spores.	Turbidity.	Scum.	Sediment.	Dull.	Wrinkled.	Characteristic.	Proteus-like.	Moss-like.	Liquefies.	Deep funnel.	Needle growth.	Surface g'wth.	Gas produced.	Visible.	Luxuriant.	Fermentation tube. Growth in closed arms.	Grows at body temperature.	Facultative anaerobic.	Curdles.	Acid.	Alkaline.	Digests.	Slimy.	Strong odor.	Chromogenesis.	Fluoresence.	Gas production.
GROUP I. **Fluorescent Bacteria.**																																	
No. 31. B. fluorescens liquefaciens,	+	—	—	+	+	—	+	+	+	—	—	+	—	—	+	+	..	..	—	+	+	..	—	—	+	—	+	+	—	+	—	—	—
21. B. fluorescens schuylkilliensis,	+	—	—	+	+	—	+	+	+	—	—	+	—	—	+	—	..	..	—	+	+	..	+	—	+	—	+	+	—	+	—	—	—
128. B. fluorescens minutissemus,	+	—	—	+	—	—	+	+	+	—	—	—	—	—	+	—	..	..	—	+	+	..	+	—	+	—	+	+	—	+	—	—	—
5. B. viscosus,	+	—	—	+	—	—	+	+	—	+	—	—	—	—	+	+	..	..	—	+	+	..	—	—	+	—	+	—	+	—	—	—	—
82. B. fluorescens non liquefaciens.	+	—	—	+	+	—	+	+	+	—	—	+	—	—	—	..	±+	+	—	+	+	..	+	—	—	—	—	—	—	—	—	+	..
90. Flügge,	+	—	—	+	—	—	+	+	+	—	—	—	—	—	—	..	±+	+	—	+	+	..	+	—	—	—	—	—	—	—	—	+	..
(See also Nos. 126 and 66, Group VII.)																																	
GROUP II. **Chromogenic type. Red.**																																	
No. 209. B. prodigiosus,	+	—	—	+	—	—	+	+	+	—	—	+	—	—	+	—	..	..	—	+	+	+	+	+	—	—	+	+	—	—	red	—	..
62. M. rubidus lactis,	—	+	±	—	—	—	+	—	+	—	—	+	—	—	+	+	..	..	—	+	+	..	+	—	—	—	±	+	—	—	red	—	..
42. M. rosaceus lactis,	—	+	—	—	—	—	+	—	+	+	—	+	—	—	—	..	±+	—	—	+	+	..	+	—	—	—	+	—	+	—	pink	—	..
115. B. ruber lactis,	+	—	—	—	+	—	—	—	+	—	+	—	—	—	+	—	..	..	—	+	+	..	—	+	+	—	+	+	—	—	pink	..	..
151,	+	—	—	+	—	—	+	—	—	—	—	+	—	—	+	—	..	..	—	+	+	..	—	+	+	—	+	+	—	—	pink	—	—

GROUP III.

Chromogenic type. (Orange.) Micrococci and Bacteria.

| | | |

TABLE I.—*(Continued.)*

NAME AND NUMBER.	MORPHOLOGY.						CULTURAL FEATURES.																BIOCHEMICAL FEATURES.											
							Nutrient broth tube.			Nutr'nt agar tube.		Gelatin plate.			Gelatin stab.					Potato tube.														
	Bacillus.	Coccus.	Diam. greater than 1μ.	Motile.	Uniting in chains.	Spores.	Turbidity.	Scum.	Sediment.	Dull.	Wrinkled.	Characteristic.	Proteus-like.	Moss-like.	Liquefies.	Deep funnel.	Needle growth.	Surface g'wth.	Gas produced.	Visible.	Luxuriant.	Fermentation tube. Growth in closed arms.	Grows at body temperature.	Facultative anaerobic.	Milk.							Chromogenesis.	Fluoresence.	Gas production.
																									Curdles.	Acid.	Alkaline.	Digests.	Slimy.	Strong odor.			
GROUP V. **Micrococci, non-liquefying.**																																	
Division A.																																	
No. 78. M. acidi lactici I.,	—	+	—	—	—	—	+	—	+	—	—	—	—	—	—	..	+	+	—	+	+	..	+	+	+	+	—	—	—	—	w-o	—	..
60. M. acidi lactici II.,	—	+	—	—	—	—	+	—	+	—	—	—	—	—	—	..	+	+	—	+	+	..	+	+	+	+	—	—	—	—	—	—	..
58. M. acidi lactici III.,	—	+	—	—	—	—	+	+	+	—	—	—	—	—	—	..	+	+	—	+	+	..	+	+	+	+	—	—	—	—	—	—	..
168,	—	+	—	—	—	—	+	—	—	—	—	—	—	—	+	—	+	+	—	+	—	..	+	+	—	+	—	—	—	—	—	—	..
130. M. viscosus lactis,	—	+	—	—	—	—	+	—	—	—	—	—	—	—	—	..	+	+	—	+	—	..	..	+	—	+	—	—	+	—	—	—	—
Division B.																																	
70,	—	+	—	—	+	—	—	+	+	+	—	—	—	—	—	..	—	+	—	+	+	..	—	+	—	—	—	—	+	—	y	—	..
75,	—	+	—	—	—	—	+	—	+	+	—	—	—	—	—	..	±	+	—	+	—	..	+	±	—	—	+	—	—	—	—	—	..
186,	—	+	—	—	+	—	+	—	—	—	—	—	—	—	—	..	—	+	—	+	—	..	+	+	—	—	—	—	—	—	—	—	..
80,	—	+	+	—	+	—	+	+	+	+	—	—	—	—	—	..	±	—	—	+	+	..	+	—	—	—	+	—	+	—	—	—	..
118. M. giganteus lactis,	—	+	+	—	—	—	—	—	—	+	—	+	—	—	—	..	+	+	—	+	—	..	+	—	—	—	—	—	—	—	—	—	..
47,	—	+	—	—	—	—	+	—	+	—	—	—	—	+	—	..	+	+	—	+	—	..	+	—	—	—	+	—	—	—	—	—	..
121. M. arborescens lactis,	—	+	—	—	—	—	—	+	+	—	—	+	—	—	—	..	+	+	—	+	+	..	+	—	—	—	+	—	—	—	—	—	..
85,	—	+	—	—	—	—	—	—	+	—	—	—	—	—	—	..	+	+	—	+	+	..	—	—	—	—	+	—	—	—	—	—	..

GROUP VI.

Micrococci. Liquefying, non-chromogenic.

No. 167.	M. citreus lactis,	-	-	-	-	−	+	±	−	−	−	+	−	+	−	−	+	−	−	+	+	+	..	−	+	−	..	+	+	−	−	−	−	−	−	w-y	−	..
37,	-	-	-	-	-	−	+	−	−	−	−	+	−	+	−	−	−	−	−	+	−	..	..	−	+	+	..	+	+	+	−	±	−	−	−	−	−	..
109,	-	-	-	-	-	−	+	±	−	−	−	+	−	+	−	−	+	−	−	+	−	..	..	−	+	+	..	+	+	+	−	+	+	−	−	−	−	..
119.	Sarcina alba,	-	-	-	-	−	+	−	−	−	−	−	−	−	−	−	−	+	±	..	..	−	+	+	..	+	+	+	−	±	−	±	−	−	−	−	−	..
142.	M. communis lactis,	-	-	-	-	−	+	−	−	+	−	+	−	−	−	−	−	+	+	..	..	−	+	−	..	+	+	+	−	+	−	−	−	−	−	−	−	..
147.	M. liquefaciens acidi I.,	-	-	-	-	−	+	+	−	−	−	−	−	−	+	−	+	−	+	..	..	−	+	+	..	+	+	+	+	−	−	−	−	−	−	−	−	..
168.	M. liquefaciens acidi II.,	-	-	-	-	−	+	−	−	−	−	+	−	−	−	−	−	+	−	..	..	−	+	−	..	+	+	−	+	−	−	−	−	−	−	−	−	..
2.	M. acidi lactis,	-	-	-	-	−	+	±	−	−	−	+	+	+	−	+	+	−	−	+	−	..	..	−	+	+	..	+	−	+	+	−	−	−	+	−	−	..

GROUP VII.

Bacilli and Bacteria. Non-liquefying and non-chromogenic.

Division A.

No. 125.	B. coli communis,	-	-	-		+	−	−	+	−	−	+	+	−	−	−	−	−	−	..	+	+	+	+	+	..	+	+	+	+	−	−	−	−	−	−	+
89.		-	-	-		+	−	−	+	−	−	+	−	−	−	−	−	−	−	..	+	+	−	+	+	..	+	+	+	+	−	−	−	−	−	−	+
208.	B. lactis aerogenes,	-	-	-	-	+	−	−	−	−	−	+	−	+	−	−	−	−	−	..	+	+	−	+	+	+	+	+	±	+	−	−	−	−	−	+
107,	-	-	-	-	-	+	−	−	+	−	−	+	−	+	−	−	−	−	−	..	+	+	−	+	−	..	+	+	−	+	−	−	−	−	−	−
137,	-	-	-	-	-	+	−	−	+	−	−	+	−	−	−	−	−	−	−	..	+	+	−	+	+	..	+	+	±	−	±	−	−	−	−	−
93,	-	-	-	-	-	+	−	−	..	−	+	+	−	+	−	−	+	−	−	..	+	+	−	+	+	..	+	+	−	+	−	−	−	−	−	−
94.	B. ubiquitus lactis,	-	-	-	-	+	−	−	−	−	+	+	−	+	−	−	−	−	−	..	+	+	−	+	+	..	+	+	+	+	−	−	−	−	−	−
206.	B. acidi lactici I.,	-	-	-	-	+	−	−	−	−	+	+	−	+	−	−	+	−	−	..	+	−	−	−	−	+	+	+	+	+	−	−	−	−	−	−
202.	B. acidi lactici II.,	-	-	-	-	+	−	−	−	−	−	−	−	−	−	−	+	−	−	..	+	−	−	−	−	−	+	+	+	+	−	−	−	−	−	−
41,	-	-	-	-	-	+	−	−	−	+	−	+	+	+	−	−	+	−	−	..	+	+	−	+	+	..	+	+	−	+	−	±	−	+	−	−	−

Division B.

126,	-	-	-	-	-	-	-	-	+	−	−	+	−	+	−	−	−	−	−	−	..	+	+	−	+	+	..	+	−	−	−	−	−	−	−	−	±	−
66,	-	-	-	-	-	-	-	-	+	−	−	+	−	+	−	−	−	−	−	−	..	+	+	−	+	+	..	+	−	−	−	−	±	−	−	−	±	−
84.	B. communis lactis II.,	-	-		+	−	−	+	−	−	+	+	+	+	−	+	−	−	−	..	+	+	−	+	+	..	+	+	−	−	−	−	−	−	−	−	−
198.		-	-		+	−	−	+	+	−	+	−	+	+	−	−	−	−	−	..	+	+	−	+	+	..	..	+	−	−	−	−	−	−	y	−	−
194.	B. communis lactis I.,	-	-	-		+	−	−	−	−	−	+	+	+	−	−	−	−	−	..	+	+	−	+	+	..	+	+	−	−	−	−	−	−	y	−	−
191.	B. radiata lactis,	-	-	-	-	+	−	−	..	−	−	−	−	+	+	−	+	−	−	..	+	+	−	+	−	..	..	..	−	−	+	−	−	−	−	−	−
74.	Proteus Zenkeri,	-	-	-	-	+	−	±	+	+	−	−	−	+	−	−	+	+	+	−	..	+	+	−	+	−	..	+	−	−	−	+	−	−	−	+	−	−
98,	-	-	-	-	-	+	−	−	+	+	−	+	−	−	−	−	−	−	−	−	..	+	+	−	+	−	..	..	−	−	−	+	−	−	−	−	−	−
12.	B. viscosus lactis II.,	-	-	-	-	+	−	−	−	−	..	..	..	..	−	−	−	−	−	−	..	+	+	−	+	+	−	−	−	−	+	−	+	+	+	−	−
25,	-	-	-	-	-	+	−	−	+	−	+	+	+	+	−	−	−	−	−	−	..	+	+	−	+	−	..	+	+	−	−	+	−	−	−	−	−	−

TABLE I.—*(Continued.)*

NAME AND NUMBER.	MORPHOLOGY.						CULTURAL FEATURES.														BIOCHEMICAL FEATURES.											
							Nutrient broth tube.			Nutr'nt agar tube.		Gelatin plate.			Gelatin stab.				Potato tube.						Milk.							
	Bacillus.	Coccus.	Diam. greater than 1μ.	Motile.	Uniting in chains.	Spores.	Turbidity.	Scum.	Sediment.	Dull.	Wrinkled.	Characteristic.	Proteus-like.	Moss-like.	Liquefies.	Deep funnel.	Needle growth	Surface g'wth.	Gas produced.	Visible.	Luxuriant.	Fermentation tube. Growth in closed arms.	Grows at body temperature.	Facultative anaerobic.	Curdles.	Acid.	Alkaline.	Digests.	Slimy.	Strong odor.	Chromogenesis.	Fluorescence.	Gas production.
GROUP VIII. **Liquefying Bacilli. No spores, non-chromogenic.**																															
No. 200. B. musci lactis,	+	—	±	—	+	—	—	+	+	+	—	+	+	+	+	+	+	—	—	+	—	..	+	+	+	—	—	—	—	—	—	—
196. B. varians lactis I., II., III.,	+	—	—	—	+	—	+	+	+	—	—	—	—	—	±	—	+	..	—	+	—	..	—	—	+	+	—	—	—	—	—	—
64. B. circulans II.,	+	—	—	—	+	—	—	+	+	—	—	+	—	—	+	+	—	..	—	+	—	..	+	—	+	—	±	+	—	—	—	—
164,	+	—	—	—	—	—	+	+	+	—	—	+	—	—	+	—	—	..	—	+	—	..	—	—	+	—	+	+	—	—	o	—
129,	+	—	—	—	—	—	+	—	—	—	—	—	—	—	+	—	..	..	—	+	+	..	+	—	+	+	+	+	+	+	—	—
120. B. anana,	+	—	—	+	—	—	+	+	+	—	—	—	—	—	+	+	..	..	—	+	+	..	+	—	+	—	+	—	—	+	—	—
68,	+	—	—	+	+	—	—	+	+	—	—	—	—	—	+	+	..	..	—	+	+	..	—	—	+	+	+	+	—	—	—	—
69,	+	—	—	+	+	—	+	+	+	—	—	—	—	—	+	+	..	..	—	+	+	..	—	—	+	+	+	+	—	—	—	—
GROUP IX. **Liquefying Bacilli. Spores small.**																															
No. 207. B. subtilis,	+	—	±	+	+	+	—	+	+	+	+	+	—	—	+	—	..	—	—	+	+	+	+	+	+	+	+	+	—	—	—	—
177. B. megatherium,	+	—	+	+	+	+	..	..	+	—	—	—	—	—	+	—	..	+	—	+	+	..	—	+	—	—	—	—	—	—	—	—
184. B. lactis V. (Flügge),	+	—	±	—	+	+	—	+	—	+	—	+	—	+	+	—	+	+	—	+	+	..	+	±	—	—	+	+	—	—	—	—
145,	+	—	±	+	+	+	—	—	+	—	—	—	—	—	+	—	..	+	—	+	+	..	—	±	—	—	+	+	—	+	—	—
114. B. mesentericus fuscus,	+	—	—	+	+	+	+	—	—	+	+	+	—	—	+	—	+	—	—	+	+	..	+	+	+	—	+	+	—	—	—	—

GROUP X.

Liquefying Bacilli, with large spores.

Division A.

| | | |

DETAILED DESCRIPTION OF BACTERIA.

GROUP I. FLUORESCENT BACTERIA.

Bacteria which produce a blue-green color either in agar or gelatin or bouillon or in all three.

No. 21. (Very common.) *B. fluorescens Schuylkilliensis. (?)* (Wright.)

Morphology; .8μ by 2μ. Chains.

Gelatin plate; a large liquefying colony, greenish and granular, later becoming surrounded by a clear pit. Later the granular center breaks up into a diffused mass.

Gelatin stab; a shallow pit, becoming deep and broad. Later a horizontal liquid layer is formed with a scum and a precipitate, and a clear, green liquid between. Growth is very slow.

Agar; a thin, white, not very opaque, moist growth. Agar green.

Potato; diffusely spreading, very thin, moist and brown.

Milk; sometimes curdles in 3 days at 20°, and at other times fails to curdle. Alkaline, and there is a slight digestion.

This bacterium appears to agree most closely with *B. fluorescens Schuylkilliensis* (Wright), the differences being only within the range of variation.

No. 31. (Very common.) *B. fluorescens liquefaciens.* (Flügge.)

Morphology; size, 1.5μ by .9μ, forming long chains.

Gelatin plate; small round colonies, with radiating marking under the surface. Surface colonies become surrounded by a clear, granular pit, the center gradually disseminating into the pit.

Gelatin stab; slowly liquefying in a rather deep funnel. The liquid is *intensely green.*

Agar; white, smooth, moist and glistening.

Potato; thick and brownish.

Bouillon; liquid becomes *very green.*

Milk; a soft, slimy curd is produced at 20°, which begins to digest at once into a yellowish green alkaline liquid.

This seems to be one of the varieties of *B. pyocyaneus* (Gessard), and closely related to *B. fluorescens liquefaciens.* It is a very slow liquefier.

The many cultures of No. 21 and No. 31 which have been isolated and studied show considerable variation, and possibly several varieties have been here included which might be properly separated. But since they seem to belong to two types, I have recognized only the two above described.

Both of these species have been found many times in milk from all the localities studied, and while these organisms cannot be regarded as distinctively characteristic of milk or cream, they are so commonly found that their presence is not unusual. Whether they indicate, as has been sometimes assumed, that the milk has been adulterated or contaminated with water is a question that I do not feel that I have data for determining.

No. 128.

No. 128 is only slightly different from No. 21 and No. 31. The chief differences are the following: Its *size is considerably smaller*, being only .5μ *by* .7μ,

whereas the other two have a diameter of .8μ and a length of 1.5μ. In gelatin stab culture No. 128 produces a very shallow pit, whereas No. 21 and No. 31 produce a deeper pit; and, moreover, the liquefied gelatin is not rendered green, or only slightly so, by No. 128. The effect of this organism upon the milk is also very slight. While the milk is curdled in two or three days, there is little or no digestion of the casein; whereas, as shown by the tables, the casein is readily digested by Nos. 21 and 31.

That Nos. 21 and 31 are varieties of the same species seems to me almost certain. No. 128 is probably a different variety of the same species, and possibly is *B. fluorescens minutissimus.* (Unna.)

No. 5. *B. viscosus.* (Frankland.)

Morphology; size, 1μ by 2μ, but variable. Showing bi-polar staining. No threads are produced, but a capsule is present. No true spores, but the double stain gives the appearance of spores.

Gelatin plate; a small white colony is produced, which sinks into a pit and rapidly liquefies the gelatin. The pit has a granular center and a clear rim, and grows into a uniformly granular colony with a radiating rim. Only a slight tinge of green.

Gelatin stab; a narrow funnel is produced, with a thick tenacious scum on the surface, with a tendency to crack and wrinkle. The liquid becomes green and later yellow and slimy.

Agar; upon agar there is produced a thin, rough, white, dry skin, which is marvelously sticky, almost like glue. The agar becomes slightly green.

Potato; abundant, brownish yellow growth.

Milk; the milk is curdled at the room temperature in two days into a soft, *slimy* mass, with no whey, the reaction being alkaline. This becomes rapidly digested into a lemon yellow liquid; after the casein is all dissolved, the whole liquid is yellow and slimy. The odor is sickish, and the mass is very slimy. At 35° there is no digestion. It is further to be noted that after cultivation of about four months in the laboratory, this organism ceased to have the power of coagulating milk, although it continued to digest the casein at room temperature. The production of the lemon color also ceased.

The most distinctive characters of this organism are its *bi-polar staining and its production of a slime.* Experiments were performed with this specie, showing that it produced a soluble enzyme. The organism was cultivated in milk for some time, and then filtered through porcelain. The filtrate, which contained no bacteria, was found to have the power of coagulating milk in an hour's time at room temperature. From such filtrate an enzyme was isolated, as described in a previous publication.*

This organism appears similar to *B. viscosus.* (Frankland.)

Nos. 82 and 90. *B. fluorescens non-liquefaciens.*

Nos. 82 and 90 are without much doubt the same organism, and are probably identical with *Bacillus fluorescens non-liquefaciens* of Flügge. Slight differences led me to recognize two varieties, which appear in the descriptions. The organisms are not very common.

* Cent. f. Bact. u. Par., XII., 1892.

Morphology; a bacillus .6μ by 1.2μ to 2μ. No. 82 forms chains, while they were not found in No. 90.

Gelatin plate; the colony of No. 82 is at first round and opaque, but white. When reaching the size 1 mm. it becomes surrounded by a green halo. Later it becomes rough, irregular in shape, but still surrounded by the green halo. The colony of No. 90 spreads over the surface in a bluish white, clear colony, which frequently shows a darker granular center. No green halo appears.

Agar; a very thin, hardly visible growth is produced, which spreads over the surface, and the agar is turned green.

Bouillon; there is formed a thin scum with a very slight cloudiness, and subsequently a sediment appears. After several weeks the liquid is quite cloudy and a sediment is noticeable, which is greenish in the case of No. 82, and brownish in the case of No. 90.

Milk; this organism produces no noticeable effect upon milk at any temperature.

Both of these cultures were inoculated into pasteurized cream, and after the cream was allowed to ripen 24 hours it was churned. The butter produced had a moderately good flavor, though not strong, and hardly different from butter made from pasteurized cream without inoculation.

These six varieties which, as indicated, probably belong to four species, include all of the fluorescent forms which have been found in the dairy products in this vicinity.

GROUP II. CHROMOGENIC TYPE. (RED.)

No. 209. *Bacillus prodigious.*

Bacillus prodigious has been found a few times in milk in this vicinity.

No. 62. *Micrococcus rubidus lactis.* (n. sp.)

This species has been found only once, but it appears to be different from any previously described bacterium. It is a *coccus* form, *non-motile*, and fails to render milk red or to curdle it. In other characters it resembles *B. prodigious.*

Morphology; a coccus about 1μ, enveloped in a non-staining capsule.

Gelatin plate; rapidly liquefying colonies, commonly with red pigment, although many colonies fail to produce the pigment.

Gelatin stab; a narrow funnel, soon widening and depositing red pigment. The whole gelatin liquefies and becomes red.

Agar and potato; a blood red, thick, luxuriant growth. Pigment not produced at 35°. Pigment most profuse at 23°.

Milk; no curdling, although the milk becomes thickened slightly, with red margin. No change in reaction. In old cultures a mass of casein is seen floating in a clear liquid.

No. 42. *Micrococcus rosaceus lactis.* (n. sp.)

This specimen was obtained originally from Uruguay, but there was later isolated from milk in Middletown a culture that agreed with it in all essential respects.

Morphology; a micrococcus, .8μ in diameter, grouped in fours.

Gelatin plate; colonies 1 mm. in diameter, of a light pink color. Under a low power they show a nucleus with a lighter zone. Upon the surface the edges are thin and the center raised.

Gelatin stab; there is a slight needle growth and a slight surface growth, which is pink.

Agar and potato; a moist, thick, not widely spreading, pink layer.

Bouillon; after a few days a pinkish sediment makes its appearance. The liquid is cloudy, with no scum.

Milk; no curdling takes place. Reaction becoming slightly alkaline, with no digestion. After two weeks a very slight pinkish tinge is noticed in the milk, which becomes quite decided in a month. Later a pink scum forms, and the milk becomes somewhat slimy.

The distinctive characteristic of this species is the *pink color* produced, which shows in the gelatin colony, in the gelatin stab growth, in the growth on agar and potato, and in the sediment in the bouillon.

No. 115. (Somewhat common.) *Bacillus ruber lactis.* (n. sp.)

Morphology; a rod .9μ by 2μ to 4μ in length, occasionally forming long bent chains.

Gelatin plate; a white opaque bead, .7 mm. in diameter, formed on the surface of the gelatin, coarsely granular and broken around the edge. Gelatin liquefies rapidly, with a central mass and an outer granular zone, which is broken and lobed at first. Later the outer zone becomes clear as it expands, and the inner mass is broken into fragments.

Gelatin stab; a shallow funnel formed, with a thin liquid layer of gelatin over the whole surface of the tube, which gradually deepens. A dense sediment appears in a clear liquefied gelatin, but no scum.

Agar; a thick, coarsely folded growth, which may be at first yellow, but later *pink.*

Potato; smooth, thick, glistening growth, with a decidedly *pink* or *salmon* tinge. A very striking characteristic.

Milk; curdled in 4 days at body temperature. The curd is soft and alkaline, and soon digests into a colorless liquid. At 20° the milk does not curdle, but digestion occurs. When used for ripening cream it produces a good flavored butter, with a pleasant aroma, though neither taste nor smell are those of typical butter.

No. 151. (Rare.)

Morphology; Bacillus .6μ by .7μ to 1.2μ, blunt ends.

Gelatin plate; surface colony round, semi-transparent, liquefying gelatin slowly, with an *orange pink color.*

Gelatin stab; slight needle growth, with slow liquefaction. A slightly cloudy liquid is produced, with a thin scum.

Agar; moist, salmon pink growth.

Potato; a moist, light orange growth, which later becomes deeper and shows various shades, from *orange* to a *brilliant red.*

Milk; no effect for 10 days, except a slight pink scum around edge and a pink tinge to milk. Then it curdles into a soft curd, which later digests into an orange colored liquid. Is alkaline.

The two following groups, III. and IV., are separated from each other by the color of a pigment which they produce, the one giving a *lemon* yellow and the other an *orange* yellow pigment. It has been found by experience that brownish colors, especially upon potato, have no significance, but that lemon and orange yellow colors are quite distinct from each other, and may be used to characterize different groups. Occasionally forms may be found in which it is a little difficult to determine to which of these two groups they belong. For convenience in classification some of these forms have been included under both groups, but as a rule the yellow and orange are sharply separated.

GROUP III. CHROMOGENIC TYPE. (ORANGE.)

No. 199. *Sarcina flava.*

This species has been occasionally found in milk.

No. 188. *M. aureus lactis.* (n. sp.)

Morphology; a coccus, size, .8μ, in pairs or in clumps.

Gelatin plate; a round, opaque colony, surrounded by a halo which is uniformly granular, somewhat indented and cracked. This increases to a large, uniformly granular liquid zone, which spreads in all directions. The liquefaction at first is chiefly below the surface.

Gelatin stab; a shallow pit is produced, which deepens into a horizontal layer with a yellow sediment and slightly cloudy liquid. Liquefaction becomes complete.

Agar and potato; an abundant, moist, glistening Naples yellow growth.

Milk; after three weeks becomes curdled and rendered alkaline. Later is partially digested into a transparent liquid, with considerable undigested sediment.

No. 103. (Quite common.) *B. aureus minutissimus.* (n. sp.)

Morphology; a bacillus, size, .4μ by 1.6μ. Three or four may be united together, and in bouillon, long tangled threads.

Gelatin plate; surface colony at first thin, irregular, branching and creeping. The deeper colonies are *burr like*, with a yellow center and radiating processes. After two days a liquefying pit is formed, with a yellow center and *irregular processes* extending into the gelatin. The whole is quite characteristic.

Gelatin stab; a deep, narrow funnel, with a brilliant yellow sediment and scum, and a somewhat cloudy liquid.

Agar; an orange yellow growth, spreading over the whole surface.

Potato; a dark orange growth of a very deep color and striking appearance.

Bouillon; a slight scum on a uniformly cloudy liquid, and a yellow sediment collects after some weeks.

Milk; at 20° becomes somewhat pasty and dark colored. Slightly slimy, and is alkaline in reaction. Butter made from cream ripened with this organism develops an aroma of decay which is unpleasant. No very decided flavor.

Nos. 113 and 104. *Micrococcus varians lactis.* (n. sp.)

This is one of the most common of our dairy species, being found very commonly in milk and cream. It is frequently found in plates made by collecting dust that falls from the body of the cow during milking. It is a very widely variable species.* Its power of producing pigment varies from a deep orange to a pure white. It commonly liquefies gelatin rapidly, but some cultures have been found with this power only slightly developed and some in which it is wholly absent. In the table I have included two of the extreme types, and the variations are mentioned below.

Morphology; a coccus form, slightly variably in size, but about 1μ in diameter. It never forms chains, and stains easily.

Motility; none.

Temperature; grows readily at ordinary temperature. Grows rapidly at a temperature of 38°, but with less color.

Mica plate; grows under the mica plate, but not much in the middle. Evidently an aerobe with slight anaerobic powers.

Gelatin plate; colonies at first forming a whitish or yellowish bead on the surface, which sinks into a slight pit with an irregular edge. The pit broadens, liquefying the gelatin rapidly, and the colony breaks up into irregular yellow masses. The pit is sometimes very deep, and contains the irregular floating masses of bacteria. The general character of the colony is very characteristic, and can be readily distinguished at a glance from other liquefying colonies. The non-liquefying variety, No. 104, simply forms a yellow colony, not characteristic.

Gelatin stab; a broad, shallow funnel is produced, with a broken yellow scum and a yellow flaky sediment. Sometimes there is liquefaction along the needle track, and sometimes not. The liquefaction is rapid, and in a few days the gelatin is completely liquefied. No. 104 forms a shallow, dry pit, with a dense yellow surface growth.

Agar; a very characteristic, dry, rough, yellow growth. The color is slightly orange, though not very deep. From this the color varies to a pure white.

Potato; a dry, granular, orange yellow growth, abundant and characteristic. Color varies to a white, and sometimes the growth is moist rather than dry.

Bouillon; in two days a slight cloudiness is produced. In six days the liquid is very cloudy, but with no sediment. In four weeks very cloudy, with a yellow sediment.

Milk; curdles at 36° in three days into a soft curd, with an amphoteric reaction. At 20° it curdles in the same way in ten days. The curd is not subsequently digested, or only very slightly. When used for ripening cream in butter making, it produced very little flavor or aroma.

No. 159. (Rare.)

Morphology; a bacillus, size, .7μ by .9μ.

Gelatin plate; characteristic. A mounded, yellowish, spreading colony, which becomes *1 centimeter in diameter, thin and almost invisible* on the edge. Is irregular shaped and very yellow.

* The variations of this species have been previously described in the Cent. f. Bact. u. Par., II., V., p. 665.

Gelatin stab; a good needle growth, with a thick yellow orange surface growth.

Agar and potato; thick, moist, glistening yellow, of a very deep orange shade.

Milk; no effect produced on milk.

Nos. 162 and 141.

See the same numbers under Group III. They are listed here also, since the pigment sometimes approaches an orange color rather than a lemon yellow.

No. 169. (Rare.)

Morphology; a bacillus, size, .5μ by 1μ. Has an irregular stain, with light spots in the middle that are not true spores. On potato they grow to a length of 4μ, with square ends, still showing irregular stain.

Gelatin plate; deep colonies are round and yellow, with a dark center and a yellow rim. Surface colonies are about .5 mm. in diameter. They are yellow and *transparent*, the transparent colony being the most distinctive character.

Gelatin stab; an abundant needle growth, with a thin, widely spreading, transparent surface.

Agar; an orange yellow, transparent, moist growth.

Potato; A widely spreading, moist, orange growth, sometimes very deep in color and almost brown.

Bouillon; orange flakes appear on the surface, and later a yellowish sediment.

Milk; is not curdled, but an orange scum and an orange sediment are produced, and the milk rendered alkaline.

No. 170. *B. aureus acidi.* (n. sp.)

Morphology; a bacillus, size, .6μ by .7μ. Occasionally somewhat longer.

Gelatin plate; colonies under the surface round, yellowish and slightly opaque. Surface colonies rather transparent, spreading, slightly irregular, 1.5 mm. in diameter, and of an orange color.

Gelatin stab; a deep, dry pit is produced, with a dry orange yellow skin lining the pit.

Agar and potato; both show an orange yellow growth.

Milk; is curdled in from two to four weeks into a moderately *hard curd, which is acid*, showing no whey and having no digestion.

No. 205. *B. aureus lactis I.* (n. sp.)

Morphology; a bacillus, size, .6μ by 1μ, with rounded ends. No chains, though three or four may adhere together.

Gelatin plate; under the surface a yellowish orange, slightly irregular colony. On the surface an orange bead, .5 mm. in diameter, which is in the middle of a slightly depressed ring, but no liquefaction of gelatin occurs.

Gelatin stab; a good needle growth and a slight orange surface growth appears.

Agar; a moist, thick, smooth ground glass growth, orange yellow in color.

Potato; a dry, or moist, orange growth.

Bouillon; an *orange yellow, tenacious scum* appears with a clear liquid.

Milk; no effect produced, except an *orange scum* and an alkaline reaction.

No. 100. *B. aureus lactis II.* (n. sp.)

Morphology; a bacillus, size, .5μ by .7μ. No chains, though two or three adhere together.

Gelatin plate; a bead with a smooth edge and a dark center is produced, 1.5 mm. in diameter, which, after a few days, becomes decidedly yellow.

Gelatin stab; a slight needle growth, with an irregular, opaque, white surface growth, not very thick.

Agar; smooth, whitish growth, which, after a few days, acquires a lemon color, and later a Naples yellow color.

Potato; an abundant growth, which is at first white, or slightly yellow and quite thick, later becoming decidedly yellow.

Bouillon; a thick, *tenacious scum* is produced, which sinks in the form of flakes, and produces a sediment.

Milk; no effect produced on milk, except that a slight slimy scum sometimes appears. Butter made from cream ripened with this organism has a prominent flavor, which is not normal and unpleasant. There is a slight and tolerably pleasant aroma. The butter on the whole is of a good quality. Nos. 205 and 100 are perhaps the same.

No. 137.

Morphology; a bacillus, size, .6μ by 1.2μ, or occasionally larger, with round ends.

Gelatin plate; the deep colonies are round and slightly granular. On the surface they spread into a thin, transparent colony, which later becomes thicker and brown and yellowish. It may occasionally form a thick, yellowish bead.

Gelatin stab; a moderate needle growth, with a yellowish irregular surface growth, with a slightly raised edge.

Agar; a not very abundant dull yellow growth.

Potato; spreads over the surface of a thin, decidedly yellow growth.

Milk; commonly curdled at room temperature in about two weeks, though sometimes becomes simply slightly lumpy. At body temperature it curdles completely, though the curd is rather soft. The action is amphoteric, and there is no digestion. No effect on butter.

No. 78. (See Group V.)

GROUP IV. CHROMOGENIC TYPE. (LEMON YELLOW.)

Nos. 48 and 116. *B. lactis erythrogenes.* Varieties I. and II.

These two cultures I regard as varieties of *B. lactis erythrogenes*, although one is a typical bacterium and the other a coccus. Variety I. appears to agree with *B. lactis erythrogenes* of Hueppe. They have each been found several times and differ from each other in a few constant characters. But since the few differences remained constant with cultivation, I have found it convenient to separate them as Varieties I. and II. Variety I. liquefies gelatin very slowly, or not at all, while Variety II. liquefies rapidly. Variety I., moreover, does not grow on potato, and turns milk red; while Variety II. grows on potato, forming an abundant yellow growth, but it does not turn milk red. The characters of Variety II. are as follows:

No. 116. *B. lactis erythrogenes.* Variety II.

Morphology; a large coccus, .8μ in diameter.

Gelatin plate; the colony is at first a bead, or flat and brownish under the microscope. Grows into a flat colony, 1.5 mm. in diameter, in four days, and then sinks into a shallow pit.

Gelatin stab; an abundant needle growth, white, with a flat, white surface growth sinking into a shallow pit, the bacteria mass forming a dense scum on the surface of the liquefying gelatin. Liquefaction occurs slowly and horizontally.

Agar; a thick, white, opaque growth, giving to the agar a *pinkish tinge*, which later becomes somewhat red. The growth on the surface becomes yellow.

Potato; an abundant yellow, moist, opaque skin.

Milk; is rendered slightly alkaline, but not curdled. After four weeks it is digested into a watery or semi-transparent liquid, yellowish in color, with a peculiar smell. It produces no effect upon butter when used for cream ripening.

No. 174. (Uncommon.)

Morphology; a bacillus, size, .9μ by 1.5μ, with rounded ends. No chains, though three or four may hang together.

Gelatin plate; the deep colonies are oval, dark, opaque, and the surface colonies are at first white and about half a millimeter in diameter, thin, sinking into a pit, with a large, yellowish nucleus.

Gelatin stab; a moderately shallow funnel is produced, gradually liquefying, with a cloudy liquid and abundant sediment, but no scum.

Agar; slightly lemon yellow growth on the surface, and the agar acquires a *pink tinge.*

Potato; white or yellow growth, which later becomes quite abundant and lemon yellow.

Milk; curdles at body temperature in three days into a soft, alkaline curd. Digests into a cloudy, colorless mass, which sometimes may be reddish yellow or amber colored, and with a slimy scum.

This organism is very similar to No. 116, above described, and is perhaps identical with it. The pink fluorescence is very slight, and the lemon yellow color more noticeable, and this has led me to separate the two.

No. 201, *Sarcina lutea*, and No. 199, *Sarcina flava*, have both been found occasionally in dairy products.

No. 117. (Rare.) *Micrococcus citreus lactis.* (n. sp.)

Morphology; a coccus, .9μ in diameter.

Gelatin plate; a smooth, opaque surface colony, 1 mm. in diameter, which in about five days becomes 2.5 mm. in diameter; very *thin and flat and decidedly yellow.* Gelatin ordinarily becomes dry before liquefaction begins.

Gelatin stab; needle growth abundant. A flat, depressed, yellow surface growth, which is sunken in the middle and slowly spreads over the surface of the gelatin. After about two weeks a slow liquefaction begins, with a floating scum on the surface of the liquid. (One variety of this species was found which liquefied the gelatin more rapidly and produced a narrow funnel.)

Agar; abundant moist growth of a brilliant yellow.

Potato; a rather dry but abundant lemon yellow growth.

Milk; rendered strongly alkaline, but no further change produced. No noticeable effect produced upon butter when used in cream ripening.

No. 167. (See Group VI.)

I regard this as a variety of No. 117. It grows, however, at 35°, and under a mica plate, and liquefies more slowly.

No. 91. (Rare.) *B. citreus acidi.* (n. sp.)

Morphology; a bacillus, size, .5μ by .8μ, with no chains.

Gelatin plate; large, white, opaque colony, becoming 2 mm. in diameter, and later turning yellow.

Gelatin stab; a good needle growth, with a spreading surface, slightly raised on the edge and depressed in the centre. This becomes lemon yellow and spreads slowly over the surface.

Agar; an abundant, spreading, lemon yellow surface growth.

Potato; a thick, white and slightly transparent growth, the center of which soon becomes yellow, and later the whole turns to a lemon yellow.

Bouillon; a slight scum is formed, which sinks in the form of flakes and produces an abundant sediment.

Milk; curdled at ordinary temperatures in 6 to 9 days with a clear, hard curd and a deep yellow layer of milk on top. *Is acid* and has a decidedly *sour odor*, with no digestion. Cream is also curdled and filled with gas bubbles. It is acid, and has a pleasantly sour odor, with no separation of whey. Used for cream ripening, it produces a good butter flavor, though slight, but no aroma.

No. 72. (Rare.)

Morphology; a bacillus, size, .8μ by 1.4μ. Produces very short chains with spores. In old cultures long threads may be developed.

Gelatin plate; produces a perfectly transparent surface colony, with an irregular edge, half a millimeter in diameter.

Gelatin stab; a moderate needle growth and a dry, white, moderately abundant surface growth.

Agar; opaque, white and shining at first and abundant. Later becomes a lemon yellow.

Potato; thick, smooth growth, which may be white where moist, but soon becomes lemon yellow.

Milk; curdles at 36° in two days, but not at room temperature. Is *acid.* No effect is produced on cream, except an acidity and sour smell and taste. Butter made from such cream has a sour, unpleasant taste. When fully ripened, has an unpleasant aroma, and is decidedly poor.

No. 105. (Rare.)

Morphology; a short rod, size, .5μ by .9μ.

Gelatin plate; colonies under the surface are rounded or oval, with a dark center and a lighter outer zone, which is sometimes lobed or striated. On the surface large, moderately opaque beads are formed.

Gelatin stab; slight needle growth, but a moderately thick, white surface growth, which later becomes dry, with a slight yellow tinge.

Agar; the agar develops on the surface a very decidedly lemon yellow growth, which is thick and abundant. The agar may, at the same time, be turned *green*, but not universally so.

Potato; growth thin and moist, but lemon yellow.

Bouillon; slightly cloudy, and with a slight tinge of *green* near the surface.

Milk; no effect upon milk at any temperature. Butter made from cream ripened with this species has no special flavor or aroma.

No. 149. (Common.) *B. citreus lactis I.* (n. sp.)

Morphology; a rod, size, 1μ by .7μ, with rounded ends. On potato and agar the rods are connected with a slimy capsule.

Gelatin plate; a minute colony, 1 mm., or a little larger. On the surface there is frequently produced a raised bead, with a central dot. The color is lemon yellow, brilliant, and even under the microscope the colonies appear *brilliant lemon yellow*, smooth and clear.

Gelatin stab; needle growth moderate to the bottom of the tube. A rough surface growth, rather thick, but not opaque.

Agar; a thin, moist, transparent lemon yellow growth.

Potato; a moderately thick, brilliant lemon yellow growth.

Milk; no effect is produced on milk or upon cream.

While quite similar to No. 105, this species differs in its gelatin colony and its *intense lemon yellow pigment.* It is quite common in milk.

No. 161. *B. citreus lactis II.* (n. sp.)

This organism agrees with the last described in all respects, except two. First, it liquefies gelatin slowly, producing a dense yellow liquid in the gelatin stab. Second, associated with this characteristic it is found that it curdles milk, producing a weak alkaline curd at ordinary room temperature.

These two organisms are apparently the same species, differing in the power of liquefying gelatin, and consequently curdling milk.

Both No. 149 and No. 161 have been found quite commonly in the milk in this vicinity, and in one case both of these types have been isolated from a single colony.

No. 187. (Rare.)

Morphology; a rod, size, .8μ by 1μ to 1.2μ. No chains, spores nor capsules.

Gelatin plate; a round, semi-opaque, slightly yellow colony produced, with no characteristic features.

Gelatin stab; a moderate needle growth, with a slightly raised surface growth. Faint yellow, but not characteristic.

Agar; a moist, smooth, glistening, lemon yellow growth.

Potato; an abundant, moist, glistening, lemon yellow growth.

Milk; no effect upon milk or cream.

This organism has no characteristic features, except the *lemon yellow color* which is produced on gelatin, agar and potato. I separate it from No. 149 because of the very moderate pigment it produces.

No. 141. (Rather common.)

Morphology; a bacillus, size, .6μ by 1μ to 2μ.

Gelatin plate; the deeper colonies are round, brown and opaque. Surface colony is more transparent, whitish and finely and uniformly granular.

Gelatin stab; a moderate needle growth, with a dry, white, spreading surface growth. Moderately thick. Somewhat irregular edges.

Agar; a thick, moist growth, which is at first white, with a tinge of yellow, later becoming lemon yellow.

Potato; coarse or fine folded skin, with a yellow color.

Milk; no effect produced on milk or cream.

No. 162.

This agrees with No. 141 in all respects, except that the growth on potato is very scanty, and there is scarcely any growth in bouillon. The two probably are the same.

No. 191. (Rare.) *B. citreus arborescens.* (n. sp.)

Morphology; a rod, size, .8μ by 4μ. Two or three may adhere together, but no long chains. Is joined by a capsule that does not stain.

Gelatin plate; a widely spreading colony, with *fine radiating rods* growing from the center, and some growing over the whole plate, with fiber permeating the gelatin in every direction. *These fibers have frequent knobs.* The fibers from two colonies will extend over a whole plate in three days. To the naked eye they look like a mould. This growth is very characteristic.

Gelatin stab; needle growth is slight, but a thick *ground glass surface* growth is produced.

Agar; white, moist and irregular, spreading in streaks over the surface.

Potato; dry and thin, but lemon yellow in color.

Milk; no effect, except a slight transparency and an alkaline reaction.

GROUP V. NON-LIQUEFYING COCCI, NOT CHROMOGENIC.

Division A.

Organisms which curdle milk with an acid reaction.

No. 60. (Very common.) *M. acidi lactici I.* (Marpmann.)

Morphology; a coccus, .6μ in diameter, growing in masses.

Gelatin plate; forms rounded beads, finely granular, but with a smooth edge, and not characteristic.

Gelatin stab; moderate needle growth, rough and beaded. The surface is rough and irregular, moderately thick.

Agar; an opaque, white growth, which may grow down into the agar from the needle track, later becoming Naples yellow.

Potato; white, somewhat thick and spreading, and later becoming yellow.

Milk; at 20° is *rendered acid*, but not curdled, though such milk will curdle when boiled. At 35° is curdled into a hard curd which is *acid.* Cream is slightly thickened, rendered acid and sour. Butter made from the same has a decidedly good flavor, but practically no aroma.

No. 78. *M. acidi lactici II.*

This organism agrees with No. 60, except that it occasionally produces yellow pigment, and does not so readily grow without oxygen. The two are probably the same, and they are very similar to the following.

No. 58. *M. acidi lactici III.*

Morphology; diameter, .8μ.

Gelatin plate; a colony, at first yellowish, then raised into a white bead. Not characteristic.

Gelatin stab and agar; not characteristic.

Potato; an extremely abundant, thick, shining growth. It may sometimes be 2 mm. to 3 mm. in thickness, of a flesh color, and is especially characteristic.

Milk; is rendered strongly acid, but does not curdle at 20°, though it curdles at 35°. Cream acquires a rather strong, sharp, penetrating, pleasant odor.

These three organisms appear to me to be similar to *B. acidi lactici* of Marpmann.

No. 168. (Rare.)

Morphology; coccus, .9μ, and diplococci.

Gelatin plate; the deep colonies are round and opaque. On the surface they grow into a snow white bead, extremely opaque, which grows to the size of 2 mm., and then sinks into a pit, which sometimes liquefies and sometimes does not.

Gelatin stab; a beaded needle growth. On the surface there is formed a white skin, which sinks into *a pit, commonly dry*, though sometimes with a slight liquid.

Agar; an abundant snow white growth.

Potato; a hardly visible thin white streak.

Milk; is rendered acid and curdles when heated, but does not curdle normally.

This organism may be identical with No. 147 (Group VI.). As seen from the above description, it is probably a liquefier whose power of liquefaction is sometimes completely lost. In other respects it agrees very closely with No. 147.

No. 130. (Rare.) *M. viscosus lactis.* (n. sp.)

Morphology; a coccus, .9μ in diameter.

Gelatin plate; surface colonies are smooth and shining white; colonies ½ mm. in diameter, and not opaque.

Gelatin stab; slight needle growth. An abundant shining white surface growth, raised into a mound.

Agar and potato; not characteristic.

Milk; becomes acid, but does not curdle. It soon becomes *extraordinarily slimy*, and can be drawn out into long threads. The sliminess does not affect the churning of the cream, and produces no flavor or aroma in the butter.

This coccus does not appear to be like any of the previously described slimy milk bacteria, and I have therefore regarded it as new, and given it the name, *M. viscosus lactis.*

Division B.

Organisms which do not curdle milk nor render it acid.

The first three agree in producing chains (*Streptococci*), and differ only slightly from each other. They may perhaps be the same.

No. 70. (Common.)

Morphology; .6μ in diameter, forming chains in bouillon.

Gelatin plate; a surface colony, 1 mm. in diameter, rather opaque, with an irregular border, or sometimes a thick, raised bead.

Gelatin stab and agar; not characteristic.

Potato; cream white or yellowish white. Abundant and somewhat transparent, moist and *slimy*. Used for ripening cream, it produces a good flavored butter, without any sour taste.

No. 75. (Common.)

Morphology; diameter, .6μ; in bouillon growing into chains, with a capsule.

Gelatin plate; smooth, thick and transparent, 2 mm. in diameter, with occasional tendency toward roughness, and warts on the surface.

Gelatin stab; a slight needle growth, tapering rapidly below the surface. The surface is rather thick on the edge, with a smooth center. Is dry and transparent.

Agar; is yellowish white, quite thin and *dry*, and not widely spreading.

Potato; a dirty white or *snow white growth*. Used for cream ripening, it produces butter without taste or flavor.

No. 186. (Common.)

Morphology; diameter, .8μ to .9μ, occasionally forming short chains of 6 to 20 elements, especially in bouillon.

Gelatin plate; a round, opaque, slight yellow colony, spreading into a white, slightly raised colony, finely granular, .5 mm. in diameter.

Gelatin stab; a typical *nail colony*, with a round, smooth head, quite thick, at first white, but later showing a tinge of yellow.

Agar and potato; not characteristic.

No. 80. (Rare.)

Morphology; diameter, *1μ to 1.2μ*. Slightly longer than broad. Forms chains of 6 or 8, which resemble rods, but which break up into cocci in old colonies.

Gelatin plate; a slightly granular, white rather transparent colony, 1 mm. in diameter. Not characteristic.

Gelatin stab; needle growth slight; thin, smooth, semi-transparent surface growth.

Agar and potato; not characteristic.

Milk; is rendered somewhat *slimy* and alkaline, but otherwise unchanged. Produces butter without flavor or aroma.

No. 118. (Rare.) *M. giganteus lactis.* (n. sp.)

Morphology; extremely large coccus, 1.5μ in diameter.

Gelatin plate; produces an opaque, white bead. Not characteristic.

Gelatin stab; an abundant needle growth, but no surface growth.

Agar and potato; no visible growth, and the same is true of bouillon.

Milk; produces no effect upon milk.

The essential characteristics of this organism are its *very great size* and its markedly *anaerobic characters.* One type, probably the same, produces a very slight *acid* reaction in the milk after four weeks growth, sufficient to curdle the milk when heated.

No. 47. (Uncommon.)

Morphology; .6μ in diameter.

Gelatin plate; a round, raised, white bead, 1 mm. in diameter.

Gelatin stab; an abundant needle growth, with a thick, moist but not widely spreading surface.

Potato and agar; snow white, moist growth.

No. 121. (Somewhat common.) *M. arborescens lactis.* (n. sp.)

Morphology; diameter, .7μ. No chains.

Gelatin plate; deep colonies are irregular, granular, with a broken *fuzzy edge.* On the surface they are more regular, and become 1 mm. in diameter. There is great variation in density and in the amount of irregularity.

Gelatin stab; needle growth with *radiating fibers.* The surface growth is white, not thick, and spreads over the surface.

Agar and potato; not characteristic.

Bouillon; a very tough, *tenacious scum* is formed, which does not sink in the liquid.

No. 85. (Somewhat common.)

Morphology; .6μ in diameter.

Gelatin plate; a transparent bead, with a darker center and a scolloped border, 1 mm. in diameter. This bead is rather transparent, and spreads slightly.

Gelatin stab and agar; not characteristic.

Potato; thick and whitish, or *yellowish,* or sometimes *creamy white.* In cream the organism produces a pleasant odor, but butter made from it has no flavor or aroma.

GROUP VI. MICROCOCCI. LIQUEFYING, BUT NON-CHROMOGENIC.

No. 167. (Somewhat common.) *M. citreus lactis.* (n. sp.)

Morphology; a coccus, 1μ in diameter, in groups of 4, or irregular masses.

Gelatin plate; produces an opaque bead in a slight depression, which increases to 1 mm. in diameter, then sinks in a pit, in which the bead remains for some time in the center as a raised mound. The pit may be granular and either circular or lobed.

Gelatin stab; needle growth abundant, with not much surface at first. Later a deep, dry, narrow pit is formed, with a dense, white growth covering its walls. Still later the gelatin liquefies, and a yellowish sediment is produced.

Agar; opaque, abundant growth, with a tinge of yellow.

Potato; rather dry, whitish or with a yellowish tinge.

Bouillon; becomes uniformly cloudy, with no scum and with a *slimy* sediment. Another culture of what I regard as the same species produces a liquid pit instead of a dry pit, as here described.

Milk; culture does not curdle milk. This is the only one of the liquefying cocci found that fails to curdle milk.

I regard this as identical with No. 117 of Group IV.

No. 37. (Rare.)

Morphology; a *minute cocci*, .3μ to .4μ in diameter.

Gelatin plate; a small, granular colony, surrounded by a clear, liquefying ring. Later the nucleus breaks up, diffusing through the liquid, sometimes regular, sometimes irregular.

Gelatin stab; growth is slow. A narrow pit is formed, with an air bubble at the surface. Liquefaction complete in six weeks. Liquid is cloudy, with a heavy sediment.

Agar and potato; dirty white growth. Not characteristic.

Milk; is curdled, with weak alkaline reaction, in two days, at room temperature. At 36° in three days. A digestion follows, which is never complete.

Chiefly characterized by its *minute size.* Found only once.

No. 109. (Rare.)

Morphology; a coccus, 1μ in diameter.

Gelatin plate; a round, smooth surface colony, moderately transparent. Grows to the size of 1.5 mm., usually very flat, with a central mound, and then sinks into a pit, upon which it forms at first a very dense surface scum.

Gelatin stab; slight needle growth; a very shallow, dry pit is produced at first, in which liquid begins to collect after four or five days. Liquefaction produced very slowly in a horizontal layer.

Agar and potato; not characteristic.

Milk; is curdled at body heat in seven days, quite solid, and strongly alkaline. At room temperature it digests without curdling. The liquid is at first watery, soon becoming amber color, and later the color deepens, sometimes even to a *mahogany* color. When used for cream ripening no effect is produced on the butter.

No. 119. (Rare.) *Sarcina alba (?)*

Morphology; a sarcina form, .6μ to .8μ in diameter.

Gelatin plate; a slightly yellow, round, raised, opaque colony, which soon sinks into a pit. The pit remains clear, with a rough, granular nucleus.

Gelatin stab; a very narrow liquefying pit is produced, with a cloudy liquid. This broadens below the surface. Sometimes, however, a shallow, deep, dry pit is formed.

Agar and potato; a whitish, not abundant and not characteristic growth.

Milk; curdles in three days at 20° and in one day at 36°. Reaction amphoteric. Digestion of the curd very slight, or none. When used for ripening cream it produces a good flavored butter, with a good and typical butter aroma. One culture that I have regarded as the same produces a digestion of milk into a very *slimy jelly.*

No. 142. (Common.) *M. communis lactis.* (n. sp.)

Morphology; a *streptococcus*, with the elements .8μ to 1μ in diameter.

Gelatin plate; a round, brownish colony, slightly irregular in shape. Edge becomes after a couple of days somewhat lighter and surrounded by a liquefying pit, in which the granules spread irregularly. Occasionally a few blunt processes *radiate from the center.* The pit is rather large and at first is dry, subsequently liquefying.

Gelatin stab; a narrow funnel, with a dense, cloudy liquid is produced, with a deep, dry pit at the top. Below the air bubble the funnel spreads out into a turnip shape.

Agar; an almost *snow white* growth.

Potato; thin and watery, and spreading over the whole surface.

Milk; is curdled at 36° in three days, with amphoteric reaction. At room temperature curdles in three weeks. The curd is soft, with no whey, and the subsequent digestion is slight.

No. 147. (Common.) *M. liquefaciens acidi I.* (n. sp.)

Morphology; diameter, .7μ to 1.1μ, grouped in fours by dividing in two directions.

Gelatin plate; a densely granular liquid colony is produced, with a granular center, which is lobate or with folded edges, and which lies in a clear, liquefying pit. Later dense masses are formed outside of the center, and the whole pit becomes filled with irregular masses.

Gelatin stab; slow liquefier, producing a cloudy, shallow pit, with dense sediment. A scum with broken fragments appears. Even after three weeks gelatin is liquefied only for a quarter of an inch.

Agar and potato; a dry, snow white growth, quite opaque.

Milk; at 36° curdles in five days into a hard curd, with little whey. *Is acid in reaction, and has the smell of sour milk.* At room temperature the action is the same, although the acid is not quite so prominent. No digestion subsequently occurs, but a large amount of whey separates from the curd.

No. 168. *M. liquefaciens acidi II.* (n. sp.)

This agrees with No. 147 in many points, and may be the same. The following differences were noted:

Gelatin plate; a snow white bead, very opaque, is formed, growing to size of 2 mm., when it sinks into a slowly liquefying pit. Some colonies do not liquefy before the growth ceases.

Gelatin stab; a granular needle growth and a dense white surface on a slowly liquefying mass of gelatin.

Potato; growth is hardly visible.

Bouillon; becomes very cloudy.

Milk; is rendered acid, but the amount of acid is *insufficient to curdle* the milk unless it is heated.

These two cultures appear to me to be new, and their characteristics are so marked that I have ventured to give them a name.

No. 2. *M. acidi lactis.* (Krüger.)

Morphology; 1μ to 1.2μ in diameter.

Gelatin plate; at first a slight pit, which begins to liquefy, the colony being uniformly granular. The granules soon break up, distributing themselves through the pit, usually producing a nucleus, with a peripheral ring of granules. Outside the ring there may be a clear liquid outer zone. Eventually the whole becomes densely granular.

Agar; growth on the surface tends to become wrinkled, tenacious and sticky, and develops a yellowish or slight *salmon* color.

Potato; an abundant growth, somewhat *folded*, of a *flesh* or *salmon* color.

Milk is curdled at 20° or at 36° into a hard coagulum, with orange masses floating on the top. The reaction is *acid.* No digestion occurs. After a few days yellow lumps of fat frequently appear on the surface. Chemical analysis has shown butyric acid and alcohol to be present.

The last three organisms are peculiar in *liquefying gelatin*, but curdling milk with an *acid reaction.* This is unusual. Three or four such micrococci have been described before by Hueppe, Freudenreich, Krüger and Kozai. I have concluded that No. 2 may be the same as the species described by Krüger and Kozai.

GROUP VII. NON-LIQUEFYING, NON-CHROMOGENIC BACILLI.

This group, which is the most important group of dairy bacteria, is a very difficult one to arrange in any satisfactory manner. The different species are frequently very similar to each other, and the diagnostic characters difficult to determine. I am convinced that in some cases quite different bacilli are put under the same species because of difficulty in getting diagnostic characters for separating them.

I have found it most convenient to separate them, first in accordance with their power of producing an acid reaction in milk, and secondly in accordance with their morphological characters. A few are readily distinguished by their peculiar gelatin colonies, and some by their spore production.

Division A.

Bacilli producing an acid reaction in milk.

Nos. 125 and 89. *B. coli communis.*

This species of bacillus is extremely common in milk, although by no means universally found. It seems to show considerable variation. The two numbers above given are two of the many distinct cultures which I have identified with *B. coli.* They differ slightly. No. 125 shows gas bubbles in the gelatin

stab, while No. 89 does not, and No. 125 curdles milk more slowly, not curdling for two weeks, while No. 89 curdles in six days.

Both have been used for ripening cream, but produce butter with a markedly sour taste.

While this species is very common, it is rarely abundant enough to produce much influence upon the milk. It can therefore hardly be regarded as a distinctive dairy bacterium.

No. 208. (Extremely common.) *B. lactis aerogenes. (?)*

Probably identical with *B. acidi lactici* (Grotenfeld) and *B. a.* and *b. of* Guilleleau, and *No. 8* of Eckels.

This is one of the most common species found in milk and cream. It is not only almost always found, but is also usually very abundant. Sometimes it appears to be the cause of the spontaneous souring of milk, since in some samples it is the only acid bacillus found. This is unusual, however, for though very common, it is usually far outnumbered by No. 206 and No. 202. It is also very variable in its physiological characters, as explained on page 24, but the many different cultures which I have studied have in general the following characters.

Morphology; size, .7μ by 1μ, with rounded ends.

Gelatin plate; deep colonies, opaque and oval. (Litmus gelatin turned very red.) Sometimes lobate, as if made up of many colonies. Surface colonies may be large (2 mm.), white, opaque beads, which may contain a gas bubble (dextrose gelatin). Sometimes they form projecting colonies, growing up from the surface of the gelatin to the height of 1.5 mm., though not more than .5 mm. in diameter. Sometimes they are like *B. coli* colonies, only more luxuriant.

Gelatin stab; abundant needle growth and a thick, white surface growth.

Agar; white, moist, glistening and semi-transparent. Abundant.

Potato; a creamy white, abundant, not folded growth. Moist.

Milk; at 20° rendered strongly acid, but commonly not curdling. Some cultures do curdle. At 35° curdles milk two to four days into a soft curd. In all cases the milk is strongly *acid.* There is a *typical sour milk odor.*

Fermentation tube; grows strongly in closed arm and in bulb, and produces much gas.

This includes Nos. 16, 53, 56, described in previous publications (Storrs Expt. Sta. Rep., 1890 and 1894).

The next two organisms belong to the *Typhosus type* (Fuller) which ferment milk sugar, but produce no gas.

No. 107. (Rare.)

Morphology; size, .6μ to .8μ by 1.3μ.

Gelatin plate; a thin, transparent, spreading colony, elevated into irregular ridges, becoming a centimeter in diameter, or larger.

Gelatin stab; an abundant needle growth, with a thin, transparent, spreading, irregular surface growth. *Hardly visible.*

Agar and potato; not characteristic.

Milk; not curdled at either 20° or 36°, but rendered acid, and will curdle when heated. Butter made from cream has a sour, clean taste, but not much flavor. A strong, but not typical aroma.

No. 137. (Rare.)

Morphology; size, .6μ by 1.2μ, variable.

Gelatin plate; spreading into a thin, transparent surface colony, which later becomes thicker and brownish or yellowish. It may even form a thick, yellowish bead, half a millimeter in diameter.

Gelatin stab; a good needle growth, white. On the surface an irregular, yellowish growth, spreading slightly and rather thick on the edge.

Agar; a dull yellow, transparent, but not abundant growth.

Potato; a thin, yellowish layer, which upon some moderately dry potatoes may be quite thick, but still yellowish.

Milk; sometimes not affected in the room, but in other cases is curdled in about two weeks into a soft, lumpy, incomplete curd. At 36° the *curdling* is more complete, but still soft, and the reaction is *amphoteric*. It has no effect upon butter.

This is the only non-liquefying organism found which curdles milk without rendering it acid.

The next two organisms differ from the others in producing spores.

No. 93. (Rare.)

Morphology; size, 1μ by .6μ, or in old cultures slightly larger. The old cultures show large oval spores, larger than the rods.

Gelatin plate; an irregular surface colony, streaked over the surface with irregular contorted lines. Grows to the size of 2 mm. on the surface. Colonies under the surface are lobed.

Gelatin stab; a good needle growth, with a thick, white, surface growth.

Agar; very thick and opaque and white. Later becoming somewhat yellowish.

Potato; very thick and transparent; of a whitish color, which later becomes dry and folded.

Milk; does not curdle at 20°, though will when heated. At 36° curdles in three days. Cream is rendered acid and sour, and butter made therefrom has rather an unpleasant, sour, cheesy taste.

No. 94. *B. ubiquitus lactis. (?)*

Morphology; size, .8μ by 1.2μ to1.4μ. In bouillon short chains are produced. A bipolar staining is shown, and spores are eventually produced in the middle of the rods. A non-staining capsule developed.

Gelatin plate; round, white, opaque colonies, with a dark center, frequently raised to form a bead.

Gelatin stab; abundant needle growth. Surface raised, white, forming a prominent nail head. The center is more elevated than the edge.

Agar; extremely irregular, spreading, thick, very white and smooth.

Potato; grows with extreme rapidity, forming a *transparent*, *white*, *glistening*, widely spreading growth, especially characteristic.

Milk; curdles in eleven to twelve days. Cream rendered acid and sour, and butter produced therefrom has especially good flavor, with no aroma.

I have with hesitation associated this with *B. ubiquitus* (Jordan). The differences between the two are considerable. Jordan does not describe any spore formation, and he states that *B. ubiquitus* curdles milk very rapidly, while No. 94 curdles it only after several days.

No. 206. *B. acidi lacti I.* (Esten.)

This organism, described in a previous Report of this Station (1896), must be regarded as the most important milk bacterium in the dairies of this vicinity. As described in that paper, it has been found almost universally in samples of milk from a very wide range of territory. It is by no means universally present, and if the milk from different cows be carefully studied separately, it is found that in many cases samples of milk are obtained with no specimens of this particular species present. But when mixed milk is studied it is found in almost all cases to contain this organism. Moreover, in the milk of ordinary dairies this organism forms the largest proportion of the bacteria present. In my studies of the bacteria of ripened cream it has been found that a proportion varying from 75% to 90% of the bacteria present in cream are of the species here described. It must, therefore, be looked upon as *the* dairy organism par excellence. Its description, though given elsewhere, may be for completeness sake best included here, and is as follows:

Morphology; short, plump rods, size, .7μ by 1.2μ. No chains are produced, and no spores are found.

Gelatin plate; in ordinary gelatin a small, finely granular colony produced, pearly white by reflected light, though slightly yellowish by transmitted light. In milk sugar gelatin rendered blue by litmus, the shape of the colony is characteristic and easily recognized. It is a round, opaque colony, the surface of which is always provided with *minute spines.* This spiny appearance is distinctly characteristic of this organism.

Gelatin stab; grows wholly below the surface as a rough, beaded needle track, with no surface.

Agar; no growth or a very thin, *almost invisible layer.*

Potato; growth on potato is scarcely visible.

Bouillon; becomes turbid and a sediment collects, but there is no scum, and no gas is produced.

Milk; is curdled in from six to twenty-four hours into a homogeneous jelly like curd, very hard, and containing no gas bubbles. There is no further change in the milk. It is intensely acid, and has a clear taste, with no odor.

This species is apparently identical with those described by Günther and Thierfelder, Leichmann, Weigmann and Kozai.

No. 202. *B. acidi lactici II.* (n. sp.)

Morphology; a short bacillus or coccus, .7μ by .8μ.

Gelatin plate; an extremely small, clear, slightly yellowish colony is formed, never more than 1 mm. in diameter. It grows wholly under the surface or under a mica plate, but never on the surface.

Gelatin stab; grows along the needle track as a beaded, tolerably abundant growth, but no surface growth.

Agar and potato; there is no growth whatsoever upon these, nor is there any perceptible growth in bouillon. In a *fermentation tube* containing milk sugar bouillon there is no growth even in the closed arm.

Milk; is curdled in thirty-six hours to four days into a hard homogeneous curd, which is strongly acid. There is no separation of whey and no subsequent change.

This organism, next to the last, is the most common of our dairy species. It is found with practical universality in samples of mixed milk, and is present in very great numbers in ripened cream. While the number of this organism in ripened cream is not as great as in the case of the last species, the proportion is always high, and frequently reaches 20% in samples of typical ripened cream. This organism and the last comprise in many cases over 95% of the bacteria in the normally ripened cream, and they must therefore be regarded as the two most important dairy organisms in this region. *Neither of them produces the typical sour milk odor*, such as is developed by No. 208.

No. 197. *B. lactici aerobans.* (n. sp.)

This agrees with No. 202, except that it has no effect on milk, and its growth on agar is visible though very scanty.

Possibly these are the same as *Bacillus a.* of Freudenreich.

No. 41. (Originally found in milk from Uruguay.)

Morphology; a bacillus, occasionally clinging two together, and on potato frequently forming chains. Size, 1.1μ by .6μ. When growing in potato it is slightly longer than in agar. No spores.

Temperature; grows best at about 20°–23° C.; at 35° scarcely any growth; killed by temperature of 60° C. in ten minutes.

Gelatin plate; a smooth, round colony under surface. On surface a small, grey, raised bead-like colony, spreading somewhat, reaching size of 1 mm. occasionally. Not characteristic. After several years cultivation the gelatin colony was found to be always burr shaped, with irregular, more or less radiating margins.

Gelatin stab; slight needle growth. Spreads over surface as a moist, white, thick mound, forming a nail growth. Does not liquefy.

Agar; an abundant, white, smooth, glistening layer,

Potato; raised, thick, whitish or slightly yellow-tinged layer, differing in color with amount of moisture, When very moist, is white, but when dry tends to a yellowish tinge. Grows profusely. A pleasant *aromatic odor* developed.

Milk; does not curdle either at 20° or 35°. After two to three weeks becomes slightly translucent and brownish. The reaction is slightly acid. After three to four weeks it seems to digest into a translucent mass. It acquires a *pleasant aroma.*

This bacterium has been used widely for cream ripening, producing a pure flavored butter.

Division B.

Bacilli not rendering milk acid.

No. 126. (Rare.)

Morphology; a bacillus, size, .7μ by 1.2μ.

Gelatin plate; an opaque bead, 1 mm. in diameter, slightly scolloped edge. Very white, opaque.

Gelatin stab; typical nail growth. Not characteristic.

Agar; thick, white and abundant. The agar occasionally tinged green or yellow.

Potato; a yellowish or dirty white growth. Not characteristic.

Milk, no effect. Butter made from cream ripened with this organism has a *cheesy aroma and taste.*

No. 66. (Common.)

Agrees with No. 126, except that the milk is rendered slightly alkaline and the cheesy taste does not appear in the butter. Butter on the other hand develops an excellent nutty flavor of the highest quality.

Possibly these two organisms should be classified with the fluorescent, inasmuch as they occasionally render the agar slightly green.

No. 84. (Common.)

Morphology; size, .6μ by .8μ to 1.2μ. Occasionally six or eight unite together, but no long chains.

Gelatin plate; a rounded bead, with a smooth edge, finely granular and with a dark center. It spreads over the surface as a dry, thin growth, 2 mm. in diameter.

Gelatin stab; needle growth abundant. Surface growth dry, irregular and glistening.

Agar; widely diffused growth, branching irregularly and lobate. Yellow color.

Potato; growth thin and of a yellowish or brownish or even orange color.

Milk; no effect upon milk, cream or butter.

No. 198. (Common.) *B. communis lactis II.*

Morphology; size, .8μ by 1μ. Forms short chains in bouillon.

Gelatin plate; colony of the B. coli type. Surface colony spreads into a white, bluish growth, 1.5 mm. in diameter. They are slightly yellow under the microscope, and may have a somewhat raised center. The colony is moist and glistening.

Gelatin stab; abundant needle growth, with a thin, slightly spreading, white, dry, surface growth.

Agar; not characteristic.

Potato; a slight lemon yellow tinge, but not characteristic. No effect upon milk or cream.

Differs from No. 84 chiefly in the form of the *gelatin colony.* Probably the same as No. 26. Previously described. (Storrs Sta. Rep., 1893.)

194. (Very common.) *B. communis lactis I.* (n. sp.)

Morphology; size, .6μ by .8μ.

Gelatin plate; a smooth, round, white colony, not very opaque, becoming 3 mm. in diameter, irregular and rough or lobate, or sometimes round, white, moist and regular.

Gelatin stab; needle growth abundant. A white, flat, glistening surface growth, which is first thin, but later becomes thicker and slightly yellow.

Agar; moderately thick, moist, smooth and transparent.

Potato; white, moist and thick.

Milk; no effect upon milk or cream.

This is very common in milk, though never in great numbers. It is the same as No. 55. Previously described. (Storrs Sta. Rep., 1893.)

No. 191. *B. radiata lactis.* (n. sp.) (Named also *B. citreus arborescens* on p. 43.)

Morphology; size, .8μ by 4μ. No long chains, but two or three may be united together. Surrounded by an unstained capsule.

Gelatin plate; widely spreading colony, with fine lines radiating from the center. Grows over the whole plate, with fibers permeating the gelatin. The fibers are knobbed. Fibers from two colonies may grow over the whole plate in the course of three days. To the naked eye the whole looks like a mould.

Gelatin stab; a slight needle growth, with a characteristic ground glass surface growth.

Agar; not characteristic.

Potato; a very thin growth, which may be slightly lemon yellow.

Milk; after three weeks is rendered slightly alkaline and semi-transparent.

This organism was found only once, and was unfortunately lost before its description was complete. Its very unique colony upon gelatin is, however, sufficient to distinguish it.

No. 74. (Rare.) *Proteus Zenkeri. (?)*

Morphology; size, 1μ by 2μ to 3μ, forming long threads in bouillon.

Gelatin plate; colonies especially characteristic. They start as round colonies, from which extend fine branches. These radiate widely and are at first fine and subsequently polypiform. Sometimes they are simply fine, radiating lines, not polypiform, and occasionally the colony is simply lobate, without radiating fibers.

Gelatin stab; along the needle track are lateral extensions forming *thin sheets*, thus producing the form of an inverted fir tree. Surface growth thin and irregular.

Agar; spreads rapidly from the needle track, with radiating fibers rather thick.

Potato; dirty white, brown, rough, with a sandy appearance.

Milk; no effect except a slight alkalinity. After three weeks it becomes slightly slimy. No effect on cream or butter made from the cream. Develops no aroma or taste.

No. 98. (Rare.)

Morphology; size, .7μ by 1.5μ to 2μ. Joining into chains.

Gelatin plate; a round, rough, granular colony, sometimes coarsely granular like a corn ball.

Gelatin stab; a moderate needle growth, with a thin, transparent, widely spreading, *hardly visible* surface.

Agar; moderately thick along the needle track, but with a thin, transparent, *hardly visible*, spreading edge growing over the agar.

Potato; rather scanty, but not characteristic.

Milk; no effect upon milk or cream. Butter develops a rather unusual aroma, but no flavor.

No. 12. (Rare.) *B. viscosus lactis II.* (n. sp.)

Morphology; a rod, four times as long as broad (size not measured), surrounded by a mass of slime.

Gelatin plate; a white bead, 1 mm. in diameter. Not characteristic.

Gelatin stab; abundant needle growth, with a thin, irregular rosette surface growth.

Agar; transparent and glassy, very thick and raised in irregular masses. The growth is extremely slimy, forming threads several inches long when lifted with the platinum loop.

Potato; growth greyish brown, mottled, abundant, tenacious, and slimy.

Milk; is rendered slimy and alkaline. Threads of a foot in length may be drawn from it with a platinum loop. An odor is developed in the milk, reminding one of *strong cheese*. After a month the milk becomes almost solid, although its sliminess has disappeared.

This bacillus appears to be similar in its general characters to *B. viscosus lactis* of Adamitz, but its morphology is quite different. While *B. viscosus* is nearly as broad as long, this No. 12 is a long, slender rod. It was isolated from milk in 1891, and has not been found since.

No. 25.

Morphology; a bacillus, .7μ by 2μ.

Gelatin plate; a minute, clear, round colony is produced, which is later raised into a bead, with concentric folds. It may spread to a diameter of 1 mm., and show a central nucleus with a dark outer rim. The edge may be rough and folded.

Gelatin stab; an abundant needle growth, which is rough and beaded. A slightly mounded surface growth, spreads widely and later is thin, transparent and dry. Color is white.

Agar; is white, moist and moderately thick.

Potato; is white or gray, dry and thick. Later it becomes yellowish and even brown.

The most convenient grouping of the liquefying bacilli has been found to be that adopted by Flügge, depending upon the character of the spore formation. It should be stated,

however, that less attention has been given to the liquefying bacteria than to the non-liquefying bacteria. While they are almost always present in milk, their relative number is always small in normal milk. The rapid growth of the numerous lactic bacteria commonly checks the multiplication of the liquefyers, so that they are always few in ordinary milk or cream. I am now convinced that they are of comparatively little importance in normal dairy processes. In ripened cream, as will be shown in a later paper, they are commonly only to be found in very small quantities. For these reasons less attention has been given to them in my investigations, and the list given below is therefore doubtless far from complete. The bacteria here listed doubtless include some of those described by Duclaux under the name of *Tyrothrix*, but the incompleteness of his description makes sure identification impossible. I have therefore not attempted to identify them with Duclaux's species.

GROUP VIII. LIQUEFYING BACILLI WITHOUT SPORES.

No. 200. (Rare.) *B. musci lactis.* (n. sp.)

Morphology; size, 1μ by 2μ to 5μ. Forms long chains, which look like strings of sausages. These form a tangled mass, forming a scum on gelatin.

Gelatin plate; a diffuse colony, 1 inch in diameter, made up of long fibers, growing chiefly under the surface of the gelatin, looking like a tuft of moss, thick in the center and gradually fading out around the edge. Quite characteristic *network of fibers.*

Gelatin stab; a ground glass, crumpled surface. Below surface there is a tree-like growth from the needle track, hardly visible. Liquefaction takes place slowly. There is eventually produced a liquid cone, with a central granular axis, shaped like an inverted cone. Eventually the liquefaction is complete.

Agar; widely spreading, with creeping branches on the surface like cotton threads. Eventually covering the whole surface.

Potato; growth is chiefly *under the surface.* The surface becomes rough and white and somewhat broken.

Bouillon; masses are formed floating in a clear liquid, and a scum appears later.

Milk; is curdled after three weeks, and becomes slowly digested into a translucent mass, full of flakes and showing a skin on the surface of a ground glass appearance.

No. 196. (Common) *B. varians lactis I.* (n. sp.)

Morphology; size, .8μ by 1.5μ, blunt ends.

Gelatin plate; a thin, spreading, transparent surface. When reaching a millimeter in diameter it sinks into a pit in a dense, granular mass. Sometimes

a few lobe-like shoots extend from the colony into the gelatin, *ending in prominent knobs*, quite characteristic.

Gelatin stab; a shallow cone produced. The gelatin then liquefying regularly into a dense, cloudy liquid.

Agar and potato; scanty growth, but not characteristic.

Milk; is curdled hard and rendered amphoteric, or sometimes acid. No digestion can be seen, but a watery whey subsequently deposits from a solid curd.

Nos. 176 and 139. *B. varians lactis II. and III.*

These two cultures I place with No 196. They agree in all points except the power of liquefying gelatin. No. 139 in gelatin stab forms a deep, dry pit, with no sign of liquid. No. 176 produces a dry pit, but later begins to liquefy at the bottom, and the liquefaction slowly deepens, while No 196, as shown, liquefies rapidly. The three were obtained from different localities and at different times.

They may be identical with *B. cloacae* (Jordan).

No. 64. (Rather common.) *B. circulans II.* (n. sp.)

Morphology; size, .6μ by 1.5μ. Long chains are produced in bouillon, but no spores found.

Gelatin plate; a granular bead is produced, which sinks into a dry pit. The pit liquefies, and the bacilli can be seen actively *circulating in the liquid.* Uniformly granular.

Gelatin stab; there is a growth along the needle track, producing a deep, narrow funnel, from which the liquid evaporates, so that there is a considerable portion of the funnel without liquid. A white sediment forms in the axis of the liquefying pit. The whole is peculiar and characteristic.

Agar; an abundant, yellowish growth. Not characteristic.

Potato; a somewhat thin, watery, transparent growth.

Milk; there is no curdling, but the milk digests into a weak alkaline liquid, which is cloudy and gives off unpleasant odors. Butter made from cream ripened with this organism develops a moderately good flavor and aroma. The putrefactive odor in the milk and cream is ordinarily not noticeable in the butter.

This is very similar to *B. circulans* of Jordan. I have, however, found no spores, while Jordan found them in most media. The growth on agar is also different. The peculiarities shown in the colony and the gelatin stab lead me to put it with the species described by Jordan as a *Variety II.*

No. 164. (Rare.)

Morphology; size, .5μ by .8μ to 1μ. Tapering ends and showing irregular stain.

Gelatin plate; a yellow colony in a deep pit. As liquefaction begins there is a curiously figured central lobate mass, with an outer clear zone.

Gelatin stab; a shallow, dry pit appears, which soon shows liquefaction at the bottom, an air bubble remaining for some time. Later liquefying over the whole surface into a cloudy liquid, with a dense sediment.

Agar; semi-transparent, thick growth.

Potato; moist, not very abundant growth, which may show an orange or brownish pigment.

Milk; is slowly digested without curdling into a red amber colored, watery liquid, with a jelly-like mass of undigested casein at the bottom. Is alkaline.

No. 129. (Rare.)

Morphology; size, .8μ by 1μ to 3μ.

Gelatin plate; colony at first irregular or round. It soon becomes rough and margined, and branches arise. It then develops into a liquefying colony, with a nucleus and radiating markings.

Gelatin stab; a slow liquefaction. There is a shallow pit, becoming a horizontal layer, of a cloudy liquid.

Agar; moist, white and thick. It spreads irregularly over the agar.

Potato; at first smooth, white and moist, but later becoming slightly yellowish and folded.

Milk; is curdled with an alkaline reaction and then slightly digested, the liquid becoming slimy.

No. 120. (Rare.) *Bacillus anana.* (n. sp.)

Morphology; size, .5μ by 1μ to 1.2μ.

Gelatin plate; a round, opaque, granular colony, breaking up to form a pit, covered with mottled, granular masses. There is frequently a nucleus and a zone of granular fragments.

Gelatin stab; a narrow pit, with a granular liquid. The pit broadens at the surface and contains very cloudy liquid. Later the whole gelatin is liquefied.

Agar; moist, white, abundant.

Potato; very thick, white and abundant, and having the *odor of pineapple.*

Milk; curdles at 20° into a soft curd. No digestion noticeable. No curdling at 36°.

No. 68. (Rare.)

Morphology; size, .6μ by 1μ. Shows uneven stain and a capsule.

Gelatin plate; a pit forms, filled with irregular masses. It is frequently rosette formed at first, but breaks into opaque granules as the liquefaction begins.

Gelatin stab; a deep, dry pit formed, which later liquefies, a scum appearing on the liquid.

Agar; white, moist, thick at center of the inoculation line, but with a thin, scolloped edge. Later it becomes yellow.

Potato; a very profuse, *abundant, moist, jelly-like* growth covering the whole potato. May be white or yellowish. Very characteristic.

Milk; may curdle, or digest without curdling. Is alkaline. In about twelve days it becomes a nearly transparent liquid with a yellow scum. No effect on butter when used for ripening cream.

This is similar to No. 120, except for its action on milk.

No. 69. (Rare.)

Morphology; size, .8μ by 2μ.

Gelatin plate; a liquefying colony, with a nucleus and a broad, granular margin, or sometimes uniformly granular without the nucleus.

Gelatin stab; a narrow funnel, which widens as it liquefies into a broad funnel. The liquid has a granular tinge at the surface, and is cloudy, with a slight granular sediment.

Agar; rapid growth, spreading widely into a white, opaque layer, with irregular, glistening edge.

Potato; white, or cream white, and semi-transparent.

Milk; curdles in five to six days into a soft curd, which is alkaline. It then digests into a colorless liquid, with a bitter taste. Produces butter with a sharp, sour taste, but a thoroughly *typical butter aroma.*

GROUP IX. LIQUEFYING BACILLI WITH SPORES NO LARGER THAN THE ROD.

No. 207. *Bacillus subtilis.*

Not an uncommon inhabitant of milk.

No. 177. *Bacillus megatherium.*

This species has been found once or twice. It is easily recognized from its great size, 2.5μ, in diameter, and its spores of much less diameter. Its complete characters have not been studied here.

No. 184. (Rare.) *B. lactis V. (?)* (Flügge.)

Morphology; a large rod, with square ends forming long chains.

Gelatin plate; liquefies rapidly. Under the surface appear opaque, rough gelatin colonies, with a fibrous rim. Colonies liquefy rapidly, spreading into a uniformly granular or fibrous colony, 2 cm. in size in two days. When the colonies are near together the fibers become twisted and look like anthrax colonies.

Gelatin stab; needle growth abundant. There is a horizontal liquefaction, with a rough, white, wrinkled, tough *skin, looking like a mould.* The skin later becomes somewhat yellow, and the gelatin is finally completely liquefied, with a yellow scum.

Agar; abundant, rough, whitish yellow skin, with an irregular edge.

Potato; a very abundant growth, thick and dry, forming an almost *powdery white* surface.

Milk; no curd appears, but the milk digests in one to two weeks into a translucent liquid, with a thick, *folded scum* on the surface. It is strongly alkaline.

This appears to me to be quite similar to *B. lactis V.* (Flügge). It differs, so far as can be determined from his description, only in its action on milk, which, in Flügge's organism, did not produce the folded skin on the surface of the digested milk.

No. 145. (Rare.)

Morphology; size, 1μ by 3.5μ, blunt ends. Long chains occasionally produced. Spores spherical.

Gelatin plate; colony liquefies when it reaches the size of 1 mm., forming a dense, white layer, covering the whole surface of the liquefying pit.

Gelatin stab; liquefies at first as a small cone, and this slowly spreads over the whole surface, becoming covered with a dense, white film.

Agar; not characteristic.

Potato; very thick, dirty white layer, slightly transparent and gelatinous.

Milk; no effect upon milk either at 20° or 35°.

No. 114. (Rare.) *B. mesentericus fuscus.*

Morphology; size, .8μ by 2μ, forming long chains.

Gelatin plate; deep colonies are round, smooth and transparent. The surface colonies are raised, with a thin, transparent edge and irregular rim, creeping over the surface in irregular lobes. In five days it reaches the size of 1 mm., then it sinks into a liquefying pit, the colony remaining as a *dense growth over the whole surface*, with no clear liquid ring surrounding it.

Gelatin stab; needle growth abundant. A very shallow pit, with an air bubble in its center. The pit later spreads over the whole surface.

Agar; a somewhat dry, slightly folded growth.

Potato; a gray or yellowish, thick, highly folded skin.

Milk; at 20° does not curdle but digests slowly and becomes alkaline. At 26° curdles in six days and digests. Cream ripened with this organism produces butter with no aroma nor flavor.

GROUP X. BACILLI WHICH LIQUEFY GELATIN AND FORM SPORES LARGER THAN RODS.

These easily recognizable bacteria I divided into three divisions, according to the position of the spore.

Division A. Spores in the middle of the rod (spindle formed).

Division B. Spores at one end of the rod (tetanus type).

Division C. Two spores (?), one at each end of the rods.

Division A.

Spores in the center of the rods.

No. 123. (Rather common.) *B. arborescens lactis.* (n. sp.)

Morphology; size, 1.8μ by 3μ, growing into long chains. Large spores produced of a size 1.2μ by 2μ, causing the rods to swell in the middle.

Gelatin plate; colony grows into a large *felted ground glass mass*, which sinks slowly in a shallow pit.

Gelatin stab; a thick, ground glass surface growth forms as a scum floating on a shallow funnel. This eventually becomes much folded. Later the whole becomes liquefied, and the scum remains folded and tenacious.

Agar; grows into remarkably spreading branching filamentous masses which cover the whole surface and even grow under the surface. Quite characteristic.

Potato; almost snow white, abundant growth which extends into the potato. The surface is raised into folded mounds.

Milk; rapidly curdled at 20° and at 35°, and digested into a cloudy, colorless or amber colored liquid with alkaline reaction. Butter made from cream ripened with this organism has an unpleasant flavor and aroma.

No. 154.

This organism is probably a variety of No. 123, differing only in growth on potato and in bouillon. The potato growth is scanty, the surface becomes covered with a slight, fuzzy growth, and later with small, rounded knobs containing spores. There is an abundant growth below the surface. In bouillon a jelly-like, tenacious, flocculent mass is formed in the liquid. In other respects this agrees with No. 123.

No. 131. (Rare.) *B. filiformis lactis.* (n. sp.)

Morphology; size, 1μ by 2μ. The rods have a thick capsule with a central staining body. Spores are 1.2μ by 1.8μ in size.

Gelatin plate; colony has a fine, granular center, breaking at its edge into a granular margin surrounded with a clear, liquefying zone. Later the margin shows *contorted lacing threads.*

Gelatin stab; a narrow, cylindrical liquefying funnel is formed, with a cloudy liquid. Much gas is produced showing *as bubbles on the surface of the liquid* as well as the gelatin. Sometimes, after long cultivation, it grows without producing this gas. Liquefaction becomes complete and a dense scum and sediment is formed.

Agar; may be dry and thin, but commonly forms a thick, widely spreading lobate or branching mass, which is dry, white and quite characteristic.

Potato; a moist, yellowish, slimy mass grows over the surface.

Milk; curdled in two days with little change in reaction. Cream is rendered slightly acid with a sour cream taste, and butter made therefrom has a good flavor, but no aroma.

No. 88. (Rare.)

Morphology; size, 1.5μ by 3μ. Chains of a dozen elements are formed and large spores produced in bouillon.

Gelatin plate; a liquefying pit filled with filaments. A central granular nucleus forms with coarse granular masses, which become uniformly distributed in the surrounding zone.

Gelatin stab; a simple pit is formed which at first contains no liquid, but later liquefaction occurs slowly.

Agar; yellowish or white, not characteristic.

Potato; decidedly lemon yellow at first and later becoming dry, wrinkled and quite yellow.

Milk; curdles at 20° in six days with a thick scum and a little whey. Is alkaline in reaction. Digests into an especially clear liquid with a tenacious scum and sediment. Cream develops an unpleasant odor and the fat separates as masses floating in the whey. Butter made therefrom has no taste nor aroma.

The following three organisms show considerable similarities, especially in their morphology. But the type of colony they produce in gelatin is so different that I cannot regard them as identical. They resemble somewhat the

B. mycoides of Flügge, although each shows distinct points of difference from Flügge's organism. I have therefore named them *B. mycoides lactis I., II., III.*

No. 102. (Common.) *B. mycoides lactis I.* (n. sp.)

Morphology; 1μ by 2μ in length, forming long chains with oval spores.

Gelatin plate; deep colonies are at first irregular and show irregular radiating fibers. *A proteus-like colony.* The surface colonies form a pit with a large nucleus and a loosely granular outer zone. Liquefaction slowly extends.

Gelatin stab; a narrow funnel broadening at the top is formed, with a dense sediment. It liquefies then over the surface of the gelatin, and the liquefaction deepens uniformly with a very granular liquid containing a dense white sediment.

Agar; growth is tough and *dry* and *broken easily into fragments.* Later becomes *very white* from being covered with spores.

Potato; dry and rough and even, becoming *snow white.*

Milk; curdles in two days at 36° into a soft curd, faintly alkaline. Curdles also at 20°. Digests slowly producing a rancid odor. The digested liquid is colorless, though when the digestion is complete the liquid may be amber colored. It is without effect upon the flavor or aroma of butter.

No. 124. (Common.) *B. mycoides lactis II.* (n. sp.)

Morphology; size, 1μ by 2μ. Grows into long threads. The individual elements show square ends. A capsule is developed and large spores are prominent.

Gelatin plate; a pit is formed in which a tangled mass of threads is formed very much *like anthrax colonies.* It is quite characteristic. Becomes half a millimeter in diameter and then liquefies.

Gelatin stab; a shallow funnel is produced which liquefies in a horizontal layer. The liquid is clear with a dense scum and a dense sediment.

Agar; a tough, white growth is formed, readily breaking into lumps.

Potato; growth thin and dry, almost snow white, commonly a *putty-like* texture.

Milk; curdles rapidly at 36° in one day and at 20° in a week. Digests into a cloudy liquid which is colorless or amber colored.

No. 111. *B. mycoides lactis III.* (n. sp.)

Agrees with No. 124 except in the following points:

Gelatin stab; peculiar radiating growth arises from the needle track. This is unlike the common "fir tree" type, inasmuch as the radiating growths are in branches and are as long at the top as at the bottom of the gelatin. They grow moreover obliquely rather than horizontally. Later the liquefaction begins and is finally complete.

Potato; this grows into a dry, *velvety*, spreading growth all over the surface. Later becomes very snow white and dry.

No. 138. (Rare).

Morphology; size, 1μ by 2μ to 3μ, Forming long threads in bouillon. Rods with square ends.

Gelatin plate; brownish granular colonies with an irregular edge, which become surrounded by a liquefying pit. The pit is finely granular with a nucleus. A nucleus soon breaks up into variously formed irregular masses and the whole colony becomes uniformly granular.

Agar; not characteristic.

Potato; much folded into thick, *contorted folds*, with a yellowish tinge.

Milk; the milk is, after several days, curdled into a soft curd, which digests at once into a colorless liquid, completely dissolving the casein. Cream ripened by this organism develops a very unpleasant flavor and aroma in the butter.

No. 150. (Uncommon.)

Morphology; size, .7μ by 1.3μ. Long threads of rods with rounded ends.

Gelatin plate; colonies 2 mm. in diameter forming thick, raised, yellowish masses lying in a broad pit. Liquefaction proceeds slowly; the colony remains as a flat, dense, opaque mass, folded and wrinkled. Later a peculiar *snow white mass arises in the center of the colony* looking like a mould. This is extremely peculiar and very characteristic.

Gelatin stab; a shallow pit is produced. The growth is slow, and a clear liquid is formed with a dense, yellow scum, but no sediment. Later the liquid becomes cloudy and a sediment collects which may be white or yellow.

Agar; not characteristic.

Potato; develops a wrinkled, brown skin, which later becomes dry and highly folded.

Milk; is curdled in four days at 36° and in two weeks at 20°, into a soft alkaline curd. It eventually digests into a somewhat transparent mass, but the digestion is incomplete. A very pleasant odor is developed.

No. 51. (Rare.)

Morphology; size, .8μ by 1.5μ to 2μ. Rods with square ends.

Gelatin plate; colony irregular and developing a peculiar, characteristic, contorted mass arranged in parallel rows of thread. *A proteus-like colony.*

Gelatin stab; growth is slow, and a shallow pit is formed which in about three weeks half liquefies the gelatin, but remains to the end as a cone shaped pit.

Agar; not characteristic.

Potato; a velvety white, even *snow white*, thick growth.

Milk; curdles in two days into a soft, jelly-like mass which rapidly digests into a yellowish, cloudy liquid which is alkaline. Butter made from cream ripened with this organism has but little taste and what taste it has is unpleasant.

No. 153. (Not common.)

Morphology; size, 1.2μ by 3μ to 6μ, with blunt ends. Threads not long and frequently broken.

Gelatin plate; a large colony, 1 cm. in diameter, uniformly granular, with a radiating rim.

Gelatin stab; a deep funnel formed with liquid at bottom and an air space at the top. The liquefaction increases and a broad cone of slightly cloudy liquid is produced with a scum. Later the liquid becomes clear and the scum dense.

Agar; white, opaque and moderately thick. The growth is tough and not easily broken into fragments.

Potato; a *ground glass, much folded layer is produced with liquid under the folds.* Later the folds increase and the whole becomes white.

Milk; curdles rapidly at 20° and 36° into a hard curd and no whey. Alkaline. Digests into a clear, yellowish liquid.

Division B.

Spores at one end of the rod.

No. 189. (Rare.) *B. arborescens lactis II.* (n. sp.)

Morphology; size, .8μ by 4μ. The spore is 1μ by 1.2μ. Occasionally two or three rods together, but no chains.

Gelatin plate; colonies become 1 cm. in size or larger, showing radiating fibers *strewn with knots.* The fibers themselves are fine and branching. The knots look like isolated colonies and each frequently shows secondary radiation. Fibers grow mostly under the surface. Very characteristic.

Gelatin stab; an arborescent growth underneath the surface of the gelatin. Branches extending horizontally from the needle track and ending in knobs. In two days a dry pit is formed on the surface with numerous disjointed colonies extending from this pit to the edge of the tube. Later liquefies at the surface with a dense white cloudy liquid.

Agar; surface curdled completely with a thin, hardly visible growth.

Potato; thin and scanty growth.

Bouillon; a tough scum is formed which sinks while disturbed and forms a flocculent sediment. Later the scum sinks and the liquid is slightly cloudy.

Milk; no effect produced upon milk.

Division C.

Bacilli with two spores, one in either end.

The following species is certainly peculiar. The rods are very long, from 2μ to 6μ, and in each end of the rods may frequently be seen a clear unstained body. I have regarded them as spores, even though it has generally been thought that a bacillus with two spores has not been found. At all events this species is very unlike any other found and may be most easily recognized from this apparent double spore formation. I have therefore placed it in a division by itself with a distinct specific name.

No. 190. (Rare.) *B. dispora lactis.* (n. sp.)

Morphology; size, 1.8μ by 2μ to 6μ. Spores are about 1μ to 1.5μ, variable in size. Long chains of threads are formed with rounded or tapering ends, like a string of sausages.

Gelatin plate; a round, tough colony is produced, yellowish in color, *easily removed intact by a platinum loop.* When reaching the size of 1 mm. it sinks into a slowly liquefying pit, but the mass of bacilli remain as a distinct nucleus for a long time, the liquid being clear.

Gelatin stab; a shallow funnel is formed and the liquefaction becomes complete.

Agar and potato; not characteristic except that both show a tendency to have isolated clumps rather than a uniform layer.

Milk; at 20° is curdled and rendered amphoteric or alkaline. A slight digestion is apparent.

The following list is an index to the pages on which the different organisms are described. The species which I have named or have identified with species named by other investigators are given by name as well as by number; the others by number only. In accordance with general usage the new species are indicated by the abbreviation n. sp.:

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200. B. musci lactis (n. sp.),	57
201. Sarcina lutea,	40
202. B. acidi lactici II. (n. sp.),	52
205. B. aureus lactis (n. sp.),	38
206. B. acidi lactici I.,	52
207. B. subtilis,	60
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DISCUSSION OF THE TERMS DIGESTIBILITY, AVAILABILITY AND FUEL VALUE.

BY W. O. ATWATER.

In order to make food available for use in the body it must be digested. The digestion is done at the expense of a certain amount of material which the food itself must supply. This material is essentially that which is poured into the alimentary canal in the digestive juices. That which is not re-absorbed remains in the feces in the so-called metabolic products. These latter include also the fragments of intestinal ephithelium and minute quantities of other substances. In addition a small part of the food escapes digestion. The feces are, accordingly, made up of (1) metabolic products which are mainly the residues of digestive juices and (2) the undigested residues of the food.

DIGESTIBILITY AND AVAILABILITY OF NUTRIENTS.

This brings out the distinction between the terms digestibility and availability as they are here used.

Digestibility.—This term is here used to designate the quantity or proportion of material digested. It is measured by the difference between the total food and the undigested residue. The statement applies likewise to the several nutrients—protein, fats, carbohydrates and mineral matter. To determine the amount of each which is digested the total amounts in the food and the corresponding amounts in the feces are determined, and the latter are subtracted from the former. The methods for distinguishing between the metabolic products and the undigested residue of the food have not been made sufficiently accurate to enable us to determine exactly the proportion actually digested.*

Availability.—The term availability is here used to designate the quantity or proportion of the food and of the several nutrients which can be used for the building and repair of tissue and the yielding of energy. The metabolic products, which come from the digested food, are not used for either building

* See Report of this Station for 1897, p. 157.

material or fuel, and hence are not available in the sense in which the word is here employed. The amounts of available nutrients are found by subtracting the ingredients of the feces from the corresponding ingredients of the food. The term digestible has often been used in this sense, but the distinction here made is evidently an important one. How the available nutrients of the food are actually utilized in any given case; how much benefit the body gains from a given amount of nutrients in any given diet, is another matter.

AVAILABILITY OF ENERGY.

We have spoken of the metabolic products as residues from materials used to digest the food and thus make it available for general uses. Their energy is not metabolized. In both material and energy they represent part of the cost of making the food available. But the process of digestion involves certain mechanical operations, especially the chewing of the food and the peristaltic movement which accompanies the passage of the food through the alimentary canal. For these a certain amount of mechanical energy is required. More or less energy is still further used in the secretion of the digestive juices, and finally there are the processes of cleavage and synthesis involving more or less transformation of energy. The energy actually used in all these operations, which belong mainly to the general process of digestion, comes from the part of the food which we have designated as available. Since it is used for digestion it is not available for the other work of the body. The available energy, using the word available in the broader sense, includes the energy required for the work of digestion. This energy of digestive work has not yet been exactly measured. Reasonably close approximations have been made, notably by Zuntz and Hagemann, with domestic animals. With feeding stuffs containing large amounts of cellulose and other undigestible materials, the energy required for digestive work was found to be very large. In the digestion of straw and the poorer qualities of hay this cost of handling the coarse material which resists the action of the digestive juices is so large as to require a not inconsiderable share of the total available energy. With the concentrated feeding stuffs the amount of energy required for digestive work is much smaller.

Experiments for determining the amount of energy required for the digestion of food by man have not been made. The

materials used for the food of man, however, generally contain but very little of the undigestible material the cost of handling which is so large. The removal of the hulls of grain in the milling, and the various processes in cooking help to reduce this cost to its lowest terms.

There is, moreover, a portion of the energy of the available food which is not made available in the body at all, namely, that of the incompletely oxidized material which is excreted in the urine. This comes mostly from the protein and occurs in the forms of urea and kindred compounds. It is generally assumed that the available fats and carbohydrates of the food are, under normal conditions, completely oxidized in the body. Accordingly, their available energy is their total heat of combustion. The available energy of protein, on the other hand, is taken as the difference between the total heat of combustion and the heat of combustion of the water-free substance of the corresponding urine. This subject is discussed in the following article, pages 99 and 100.

This view makes the total available energy of the food the total energy (heat of combustion) less that of the corresponding unoxidized residues of the feces and urine. It is also the total energy of the available nutrients less that of the corresponding unoxidized material of the urine. We might deduct from the total available energy the amount required for the mechanical work of digestion and other operations by which the food is prepared for use, and call the difference the net available energy, but it does not seem necessary here to insist either upon this distinction or upon the corresponding one which would separate the nutrients oxidized for this purpose from the rest of the available nutrients.

FUEL VALUE.

The term fuel value is here used to designate the value of the food for its service as fuel. Exactly how this service is rendered is not yet known. Without discussing the question as to how much of the potential energy of the food is transformed directly into heat in the body, or what proportion is first used for internal muscular work and afterwards transformed into heat, we may for our present convenience assume that the chief uses of the nutrients of food as fuel are to:—

1. Yield energy as heat.
2. Yield energy for muscular work.

3. Protect the materials of the body or of other food from consumption by being oxidized; in other words, to:—
   a. Protect protein of the body or of food from oxidation.
   b. Protect fats (and carbohydrates) from oxidation.

We may also distinguish between what might be called the physical and the physiological fuel value. The physical fuel value would be the total energy made kinetic in the body, and would be measured by the heat of oxidation of the material burned. The physiological fuel value would be represented by the actual benefit gained by the body from the use of the fuel for the different purposes which it serves. Thus the actual value to the body of the energy from a gram of fat may be, and is by some physiologists held to be, less when used for mechanical work than if used as heat. To what extent the physiological and the physical fuel values agree or disagree is not yet known. For the present purpose the term fuel value is here applied to the physical value.

DEFINITIONS.

What has thus been explained may be summarized in the following definitions.

Digestibility.—This term is used to designate the quantity or percentage of a given amount of food or of a given nutrient which is digested, *i. e.*, rendered capable of absorption, and, under normal conditions, actually absorbed from the alimentary canal.

Availability.—This term is used to designate the quantity or percentage of a given amount of food or of a given nutrient which is capable of being utilized for the forming of tissue and yielding energy. It is the total material less the corresponding material of the feces.

Fuel value.—By this is understood the energy (heat of combustion) of the material of the food which is oxidized, *i. e.*, capable of oxidation in the body. For the total food it is the total energy less that of the corresponding unoxidized materials of the feces and urine. For the protein it is likewise the total heat of combustion less that of the corresponding unoxidized residues of these excretions. For the fats and carbohydrates it is the total energy less the energy of the corresponding unoxidized material of the feces.

THE AVAILABILITY AND FUEL VALUE OF FOOD MATERIALS.

BY W. O. ATWATER AND A. P. BRYANT.

INTRODUCTION.

The Storrs Experiment Station has devoted considerable attention to the study of the food and nutrition of man. Not only are such studies authorized by the Act of Congress establishing the Stations, but the Legislature of Connecticut makes a special appropriation to the Station for the purpose, and the Station coöperates with the U. S. Department of Agriculture in these inquiries. The lines of research followed by the Station have included the analyses of a large number of food materials, the carrying on of a considerable number of studies of actual dietaries of people of different classes in Connecticut, the determination of the proportions of nutrients in food of mixed diet which are actually digestible and available for use in the body, and the study of the fundamental laws of nutrition by experiments with men in the respiration calorimeter.

The purpose of the present article is to summarize* some of the results of these studies, and of similar investigations elsewhere, in their bearing upon the availability and fuel value of different food materials or classes of food materials to the human body. To this end recourse has been had to (1) the data obtained from a compilation of over 4,000 analyses of American food materials; (2) results arrived at by different American and European investigators concerning the heats of combustion and fuel values of different chemical compounds, groups of compounds and kinds of food materials; and (3) the statistics of over 100 digestion experiments, and over 200 dietary studies carried out in the United States.

* A more extensive treatment of this subject is being prepared for publication elsewhere.

THE NUTRIENTS OF FOOD.

For the maintenance of life and activity the human machine requires material for the building and repair of its parts and for combustion to furnish heat and the energy required for external and internal muscular work. It is customary to classify the nutrients of the food into four groups—protein, fats, carbohydrates, and mineral matter or ash.

PROTEIN—NITROGENOUS NUTRIENTS.

The term protein is commonly applied to all the nitrogenous nutrients in the food with the exception of the nitrogenous fats. It includes a number of widely different groups of compounds with correspondingly different nutritive values. The protein compounds may be roughly divided into three groups. The first will include the most important of the nitrogenous nutrients, such as albumen of meat and egg, casein of milk, myosin of meat, gluten of wheat, etc., all of which are sometimes grouped together as albuminoids. With these may be grouped also the so-called gelatinoids, such as chondrigen, gelatin, etc., derived from animal connective tissue. The members of this latter class are by some writers called proteids and by others albuminoids. Both of these classes are, in this article, grouped together as proteids. Distinguished from these are the third group, the non-proteids, including the creatin, creatinin and other so-called extractives of meat, and the amids, etc., of vegetable foods.*

Sources and uses.—Protein is found in greater or less amounts in nearly all food materials, except the pure fats, sugars, and starches. The chief sources are meats, fish, eggs, and milk among the animal, and the legumes and cereals (beans and peas, wheat, corn, etc.) among the vegetable food materials. The garden vegetables and fruits furnish a very small amount of protein, and even this has a low nutritive value on account of its large proportion of non-proteids. The protein of animal foods and the cereal grains is very largely composed of true proteids. Only these, and especially those here called albuminoids as distinguished from the so-called gelatinoids, are

* See discussion of this subject, with reference to authors, in U. S. Dept. Agr., Office of Experiment Stations, Bul. 65, p. 18. The terminology here employed is that adopted provisionally by the Association of American Agricultural Colleges and Experiment Stations.

capable of being transformed into nitrogenous body tissue, and thus go to form the blood, muscle, tendon, brain, nerves, etc. The non-proteids appear to have but little nutritive value, unless it be in some cases, for fuel. It may be that some of them have an especial value as sparers of protein, *i. e.*, for protecting the protein of food or body tissue from consumption. But too little is known of their functions to warrant very definite assumptions.*

Proportion of proteids and non-proteids.—In analyses of food materials by current methods it is the almost universal practice to take the product obtained by multiplying the total nitrogen of the food by 6.25 as a measure of the total nitrogenous material, *i. e.*, protein; in other words, to assume that protein contains 16 per cent. nitrogen. This involves two errors. In the first place the proportion of nitrogen in the non-proteids taken collectively is greater than in the proteids, and multiplying the nitrogen by 6.25 gives a value generally greater than the actual amount of nitrogenous material. In the second place the non-proteids have little nutritive value. Both these errors, therefore, tend to make the estimate of nutritive value too large. It would perhaps be better to leave the non-proteids out of account in estimating the nitrogenous, *i. e.*, tissue-forming material of food. Unfortunately our present chemical methods for the separation of the proteids and non-proteids in food materials are unsatisfactory. The comparatively few determinations now on record of the proportions in a given food material do not accord with each other and cannot be considered reliable. Until exact information concerning the proportion of proteids and non-proteids in different classes of food materials is obtained recourse must be had to the best data available. In flesh the proportion of non-proteids, *i. e.*, so-called extractives or meat bases, appears to be larger than has sometimes been supposed, but the data upon the subject are very inadequate.

The nitrogen in the cereal grains and their manufactured products is, like that of meats, mostly in the form of proteids, although a small proportion exists in the form of amids, of

* It has been suggested that asparagin may serve as nitrogenous nutriment for the intestinal bacteria and thus protect the proteids which might otherwise be broken down.

which asparagin may be taken as the type. The data concerning the proportions of these different nitrogenous compounds are few, but it appears from the work of Teller[1], Snyder[2], Wiley[3], and others that not less than 96 per cent. of the nitrogen of the seeds of cereals (and probably the legumes) may be assumed as present in proteid combinations, and not over 4 per cent. in non-proteid combinations.

While the proportion of non-proteids in animal foods and in the cereal grains and their manufactured products is relatively small, the quantity in vegetables and fruits is at times large, so that in some cases as much as two-thirds of the total nitrogen may occur in non-proteid forms. The methods of separation are too unsatisfactory and the amount of data too small and conflicting to enable us to estimate the exact proportion of proteid and non-proteid nitrogen in the different vegetables and fruits. From the best information available we are led to the rough estimate that, in round numbers, 60 per cent. of the nitrogen in vegetables such as potatoes, turnips, cabbage, lettuce and the like, and 70 per cent. of that in fruits occurs in proteid combinations.

The nitrogen factor of protein.—It has already been pointed out that the portion of nitrogen in protein compounds varies considerably. It has for a considerable time been the general custom to assume an average of 16 per cent. of nitrogen in protein, including both proteids and non-proteids. In other words the total nitrogen has been multiplied by the factor 6.25 to obtain the amount of protein in the given material. The proteids of muscular tissue, such as are found in ordinary meats, appear to contain, in general, about 16 per cent. and the non-proteids of such tissue a somewhat larger proportion of nitrogen. However, neither the amount of these non-proteids nor their proportion of nitrogen seems to be sufficient to cause any large error in the use of the factor 6.25 for estimating the total protein.* In the flesh of some kinds of fish, as the cod and more especially the skate, the total nitrogenous material seems to

1. Arkansas Exp. Sta., Bul. No. 42, p. 100.
2. Minn. Exp. Sta., Bul. No. 63, p. 528.
3. U. S. Dept. Agr., Division of Chemistry, Bul. 13, Part IX., p. 1247.

* This view is confirmed by the results (unpublished) of recent investigations by Prof. Grindley, Univ. of Illinois, in coöperation with the U. S. Dept. Agr.

contain more than 16 per cent. nitrogen.* It is probable that on the whole the factor 6.25 gives a tolerably accurate measurement of the protein of fish. The same is doubtless true of eggs. The protein of cow's milk, according to the small number of reliable investigations now available, appears to contain a trifle less than 16 per cent. of nitrogen, but hardly enough to warrant at present the use of any other factor than 6.25. It seems best, therefore, to retain this factor for the protein of all common animal food materials.

The proteids of the cereal grains appear to contain on the average more than 16 per cent. of nitrogen. The proportion in different cereals has been the subject of study by a number of investigators, notably Osborne† in this country and Ritthausen‡ in Europe. Ritthausen in a review of this subject in 1896 summarized the results of inquiry up to that time regarding the proportions of nitrogen in different proteids. He grouped the cereals according to the average proportion of nitrogen in the total protein matter, making three classes, those containing approximately 17.5, 16.7 and 16 per cent. nitrogen respectively, or in other words, those in which the protein is computed by multiplying the nitrogen by the factor 5.70, 6.00 and 6.25 respectively. Wiley§ has reviewed the work of Osborne upon the proteids of the different cereals and arrived at factors for the calculation of the protein in these products not materially different from those of Ritthausen. The grouping in Table 2 on page 79 conforms with the conclusions reached by these two investigators.

We have found extremely few satisfactory data concerning the composition of the proteids of vegetables and fruits. In lack of more definite information concerning the exact proportion of nitrogen it seems best for the present to retain the customary factor, 6.25, for calculating the proteids, and, taking asparagin as the type of the non-proteids, to use the factor 4.7‖ for estimating their amount.

The factor for estimating the total nitrogenous matter or protein from the total nitrogen will thus depend upon the

* In the flesh of the skate this may perhaps be due to the accumulation of urea or allied compounds in the tissues.

† Reports Conn. Agr. Exp. Sta., 1890, *et seq.*

‡ Landw. Vers. Stat. 47 (1896), p. 391.

§ U. S. Dept. Agr., Division of Chemistry, Bul. 13, Part IX., pp. 1171–1192.

‖ Asparagin contains 21.2 per cent. nitrogen.

proportions of proteids and non-proteids as well as upon the percentages of nitrogen in each. In the animal foods and in the cereal grains the difference between the amounts of true proteids and the amounts of protein, which include in addition the non-proteids, is so small that little error is introduced in multiplying the total nitrogen by the factor for the proteids in estimating the total protein. In considering the nutritive value of the nitrogenous matter of the vegetables and the fruits, however, the case is quite different, since the non-proteids appear to form something like one-fourth of the total nitrogenous matter. Indeed, in view of the fact that the protein is commonly taken as the measure of the tissue forming material of the food, it might be more nearly correct to consider simply the proteids in the vegetables and fruits, either leaving the non-proteids out of account entirely or including them with the fats and carbohydrates as fuel ingredients. But since some of the non-proteids occurring in vegetables may have a special value as protectors of the protein of the body or of food from consumption there is a partial excuse for including them in the estimates for protein of these foods until more exact information regarding their composition and nutritive values shall accumulate.

The nitrogen factor for vegetables and fruits, however, will be quite different from that for animal foods or for cereal products. If we suppose that 60 per cent. of the nitrogen of the vegetables is in proteid combination and 40 per cent. in non-proteid combination we may calculate the nitrogen factor in the following manner: One gram of nitrogen may be considered as representing .6 gram in proteid and .4 in non-proteid combination. The proteids corresponding to the .6 gram of nitrogen would be found by multiplying .6 by 6.25 and would amount to 3.75 grams. The .4 gram of non-proteid nitrogen may be assumed to exist in forms equivalent to asparagin containing 21 per cent. of nitrogen, corresponding to a protein factor of 4.7. This would give $(.4 \times 4.7 =)$ 1.88 grams of non-proteids. The 1 gram of nitrogen would thus correspond to $(3.75 + 1.88 =)$ 5.63 grams of protein. For the present purpose we may assume that one gram of nitrogen in vegetables corresponds to approximately 5.65 grams of protein. This makes the nitrogen factor 5.65. In a similar way the factor

for calculating protein from the nitrogen of fruits is found to be 5.80.

In ordinary tables of percentage composition the values for protein in vegetables and fruits are calculated by use of the factor 6.25, which evidently gives too large results. It naturally follows that the figures for carbohydrates, which are obtained by difference, *i. e.*, by subtracting the sum of the percentages of protein, fat, ash and water from 100, are too small by a corresponding amount. It is easy to compute the quantities of protein according to the factors above assumed from the quantities according to the factor 6.25 by multiplying by certain constant values. Thus protein as N. × 6.25 may be converted to protein as N. × 5.70 by multiplying by .912 and to protein as N. × 6.00 by multiplying by .950.

The following table gives the factors here proposed for calculating the amounts of protein in different groups of food materials from the total nitrogen. In addition the factors for changing protein as N. × 6.25 to protein as N. × 5.70, 6.00, etc., are given. Where protein is changed from one basis to another, however, the difference between the old and the new value must be added to the carbohydrates.

TABLE 2.

Proposed nitrogen factors for the protein of different groups of food materials.

KIND OF FOOD MATERIAL.	Factors here proposed.	Factors for computing protein according to proposed factors from protein as N. × 6.25.
Animal foods,	6.25	—
Wheat, rye, barley, and their manufactured products,	5.70	.912
Maize, oats, buckwheat, and rice, and their manufactured products,	6.00	.960
Dried seeds of legumes,	6.25	—
Vegetables,	5.65	.904
Fruits,	5.80	.928

FATS AND CARBOHYDRATES—FUEL INGREDIENTS.

The fats and carbohydrates in the food may be considered together in view of their similarity of use in the body. Their function is mainly that of fuel to yield energy for warmth and

muscular work. Unlike the proteids they cannot form nitrogenous tissue, though they are contained and stored in the fluids and tissues of the body. Thus large amounts of fat are stored in adipose or fatty tissue where it forms a reserve supply of fuel for future use. Both the fats and the carbohydrates, by being themselves consumed, spare the more essential and costly nitrogenous matter of food and body tissue from consumption.

PROPORTIONS OF NUTRIENTS SUPPLIED BY DIFFERENT GROUPS OF FOOD MATERIALS IN THE AVERAGE DIET.

In discussing the availability and fuel value of the nutrients of food we have to consider not simply the individual food materials or the groups into which the food materials may be classified, but also the proportions of these individual materials and groups in the average diet. What we wish to get at is the nutritive value of each kind of food as it is actually eaten as part of a mixed diet. Thus in certain digestion experiments milk has been found to be more completely digested and thus more fully utilized when it is taken with bread than when it formed the sole diet. Furthermore different food materials or nutrients of different food materials differ considerably in digestibility and availability even when the conditions for utilizing them are most favorable. If we wish to obtain figures for the average availability and fuel value of protein, fats and carbohydrates of ordinary diet we must know not only the availability and fuel value of each of the different kinds or classes of food materials, but also the proportion in which these occur in the diet and the proportions of the total protein, fats and carbohydrates that are obtained from each. These can be learned only by careful examination of a large number of dietary studies. Fortunately the results of some 250 such studies carried on in this country are now on record. Of these 185 seem to the writers to be of such character as to warrant including them in making general estimates of the proportions of the different kinds or groups of food materials in the average diet and the proportional amounts of the different nutrients furnished by each group in the whole diet.

In examining the 185 studies they are first divided into classes according to the occupation of the persons studied. The majority of the studies were of families of day laborers, mechanics, farmers, professional men, etc. There were also a number of dietaries of boarding houses and of college students' clubs, and a few of individuals or special groups of persons, especially of athletes, as rowing crews, foot-ball teams and bicycle racers. They were made in different parts of the United States, from Maine to California. All belong to the nutrition investigations which have been carried out for some years past under the auspices of the U. S. Department of Agriculture by investigators connected with a considerable number of educational and scientific institutions.*

The food materials used in each dietary were divided into the following groups:

Beef and veal,	Corn meal, rye and buckwheat flour,
Mutton and lamb,	Oat meal, rice and wheat preparations,
Pork,	Wheat flour, bread, crackers, pastry, etc.,
Poultry,	Starch,
Fish,	Sugar,
Eggs,	Dried legumes,
Butter,	Potatoes and sweet potatoes,
Cheese,	Other vegetables,
Milk and cream,	Fruits.

The published statistics of each study show the total weights of the nutrients—protein, fats and carbohydrates—in each food material in each dietary. From these data the total weights of nutrients in each group of food materials were found. From these figures for total weights of protein, fats and carbohydrates in the different groups—beef and veal, dairy products, cereals, vegetables, etc., there were computed the percentages which these weights formed of the total amount of protein, fats and carbohydrates in the diet. In a similar manner the statistics of the total food materials in each dietary were used for calculating the percentages of the whole occurring in each group of materials.

Having thus found the proportion of total foods and the different nutrients that were furnished by the different kinds or groups of food materials in each dietary, the averages

* The original data are to be found in the Nutrition publications of the Office of Experiment Stations and in the Reports of this Station.

were compared for all the dietaries of each class and finally for all the 185 dietaries. These final averages are shown in Table 3.*

TABLE 3.

Relative proportions of total food and of total nutrients supplied by different groups of food materials in average of 185 dietary studies.

KIND OF FOOD MATERIAL.	Total Food.	Protein.	Fat.	Carbo-hy-drates.
	%	%	%	%
Beef and veal,	10.3	24.6	19.5	—
Mutton and lamb,	1.4	3.3	3.8	—
Pork,	5.4	8.8	30.0	—
Poultry,	1.1	2.6	1.2	—
Fish, shell fish, etc.,	1.9	3.7	.8	.1
Total meat, etc.,	20.1	43.0	55.3	.1
Eggs,	3.0	5.9	4.3	—
Butter,	1.9	.2	19.7	—
Cheese,	.4	1.6	1.6	—
Milk and cream,	19.9	10.5	10.7	5.3
Total dairy products,	22.2	12.3	32.0	5.3
Total animal food,	**45.3**	**61.2**	**91.6**	**5.4**
Cornmeal, rye, and buckwheat flour,	1.8	1.9	.4	5.2
Oatmeal, rice, and wheat preparations,	1.3	2.1	.6	3.6
Wheat flour, bread, crackers, pastry, etc.,	18.7	26.5	6.0	45.9
Total cereal products,	21.8	30.5	7.0	54.7
Starch,	.1	—	—	.2
Sugar,	5.5	—	—	21.0
Dried legumes,	.6	2.0	.1	1.3
Potatoes and sweet potatoes,	13.7	3.9	.3	10.0
Other vegetables,	7.4	1.8	.4	2.5
Total vegetables,	21.1	5.7	.7	12.5
Fruits,	5.6	.6	.6	4.9
Total vegetable food,	**54.7**	**38.8**	**8.4**	**94.6**
Total food,	**100.0**	**100.0**	**100.0**	**100.0**

It thus appears that, in the average of these 185 dietaries, not far from 43 per cent. of the protein was furnished by meats

* The detailed figures from which the averages are computed will probably be given with a more complete discussion of the subject in a Bulletin of the Office of Experiment Stations.

and fish, 6 per cent. by eggs and 12 per cent. by dairy products, making a total of 61 per cent. from animal food materials. Of the remaining 39 per cent. which came from the vegetable food materials, 30 per cent. was supplied by the cereals, 2 per cent. by the dried legumes, 6 per cent. by garden vegetables including potatoes, and 1 per cent. by fruits. More than 90 per cent. of the fat was of animal origin, and more than half came from meats, while nearly one-third was furnished by dairy products. On the other hand only a little over one-twentieth (5.5 per cent.) of the carbohydrates was of animal origin, while 55 per cent. came from the cereal products. It is a little surprising to note that over one-fifth of the total carbohydrates in these 185 dietaries studied was furnished by cane sugar, molasses, etc.

How closely these figures represent the average diet it is impossible to say. There is a large proportion of the population of the southern states, including the bulk of the colored people and of the poorer whites in the country districts, who live mainly upon corn meal, fat pork and molasses. A considerable number of dietaries of the people of these districts have been studied, but they are not included in the 185 studies above summarized. There may be other exceptions also, but it seems to us probable that these figures in Table 3 are not very far from a fair representation of the actual distribution of the different food materials and nutrients in the average diet of persons of the industrial, commercial, and professional classes in the United States.

THE AVAILABILITY OF THE DIFFERENT CLASSES OF NUTRIENTS IN FOOD OF MIXED DIET.

The value of food for nutriment depends not only upon the total amounts of nutrients but also upon the amounts which the body can make available for its support. The proportions of the different nutrients which the body can digest and utilize from different food materials are learned by digestion experiments. Such experiments involve the accurate measurement of the amounts of the different kinds of nutrients consumed in the food during a given period and the corresponding amounts excreted in the feces. This last material is made up of the

undigested residue of the food, and of the so-called metabolic products. The latter consists mainly of residues of the digestive juices. Later research has shown that in man the actual amount of undigested nutrients makes up relatively a much smaller portion of the intestinal excretion than was formerly supposed. Indeed some investigators are inclined to take the ground that the nutrients in ordinary food materials, properly prepared, are almost wholly digested by persons in health, and that the solid excreta are almost entirely made up of the so-called metabolic products and residues from the alimentary canal.* While the feces do not give an exact measure of either the actual amount of the different nutrients which remain undigested in their passage through the alimentary canal or of the amounts of digestive juices used for the digestion, they do give us a measure of the availability of the food for use in the body. If the same quantities of two different food materials require the same amounts of digestive juices to prepare them for absorption, but the first is more completely digested, *i. e.*, leaves less undigested residue than the second, the first is more available. So likewise if both are equally digestible but the former requires more of the digestive juices to digest it, it may be regarded as really supplying a less amount of available material to the body.

The experimental data as to the digestibility of different kinds of nutrients in different classes of food materials are as yet limited. There are on record a considerable number of digestion experiments with men. In some of these single food materials were used. In others an ordinary mixed diet of more or less varied character was employed. The experiments with single food materials or with very simple mixed diet give data for estimating the coefficients of availability of the nutrients of individual food materials. From such data we have prepared tentative coefficients for the availability of the nutrients of a number of the more common kinds of food materials such as meats, milk, wheat bread, potatoes, etc. It is, however, a question whether these coefficients could be correctly applied to the same food materials when they are eaten in the

* See discussion of this subject in Storrs Reports, 1896, p. 163 and 1897, p. 154. This matter will also be discussed in more detail in a future bulletin of the Office of Experiment Stations of the U. S. Department of Agriculture.

usual way as components of an ordinary mixed diet. Fortunately we have a means for obtaining a reasonably definite idea as to their accuracy under the latter conditions. There are now on record the results of about 100 American digestion experiments with men on mixed diet. Most of these were conducted by Prof. C. E. Wait at the University of Tennessee, Knoxville, and by the writers and associates. In these experiments 13 persons have served as subjects. The diet in each case was simple and made up of common food materials, and was entirely normal in amount, proportions of ingredients and method of cooking. In each experiment the ingredients of the feces were compared with the total amounts of nutrients in the food. The coefficients of availability thus obtained apply therefore to the total food eaten and not to the individual food materials. Now if the coefficients of availability which were assumed for the different kinds of food materials as above described represent the actual availability of the same materials when they are eaten in mixed diet, then by applying them to the materials consumed in these experiments we should get estimated results which would agree with those found by experiment. We may therefore use the agreement or disagreement of the estimated availability of the total nutrients of the diet used in these experiments with the results actually found as a measure of the correctness of the assumed coefficients of availability. This has actually been done. Using the coefficients as first assumed there was some discrepancy between the computed and experimental results. The coefficients were slightly altered, the change being such as seemed to us most probably correct and the computations were repeated. In this way coefficients were found which brought results agreeing very closely with those of actual experiments.

In selecting coefficients for availability, food materials were divided into the following groups: (1) Animal food materials, as meats, fish, milk, etc. (2) Cereals such as wheat flour, corn (maize) meal, etc. (3) Sugars and starches. (4) Vegetables, as potatoes, cabbage, turnips, etc. (5) Fruits.

The coefficients of availability assumed are shown in the following table.*

* The details of the calculations of which this and the following tables summarize the results will probably appear in a Bulletin of the Office of Experiment Stations.

TABLE 4.

Coefficients of availability of nutrients of different groups of food materials and of total nutrients of mixed diet.

	Protein.	Fats.	Carbohydrates.
	%	%	%
Animal foods,	97	95	98
Cereals,	85	90	98
Legumes, dried,	78	90	97
Sugars and starches,	—	—	98
Vegetables,	83	90	95
Fruits,	85	90	90
Vegetable foods,	84	90	97
Total food,	92	95	97

In applying the assumed factors for availability (coefficients of availability) to the results of actual digestion experiments with men upon mixed diet the method employed was in brief as follows: The amount of available protein, for example, was calculated upon the assumption that 97 per cent. of the protein in animal food, 85 per cent. of that in cereal food, 78 per cent. of that in the dried legumes, 83 per cent. of that in vegetables and 85 per cent. of that in fruits can be utilized by the body. The sum of the amounts of protein thus computed as available in the different groups divided by the total amount of protein in the food eaten gives the calculated coefficient of availability. The computed coefficients of availability for the fats and carbohydrates were obtained in a similar manner.

The average variations between the coefficients as found and as calculated are inconsiderable. In some individual experiments they reached 5 per cent. for one or more nutrients. In some cases the calculated values were larger, in others they were smaller than those found by experiment. These variations in individual experiments are not at all surprising. Different specimens of the same food material may differ in availability with differences in composition and method of cooking, just as different persons may vary in their capacity to digest the food. But these minor variations disappear in the average of a large number of experiments, as is seen in the figures for all the experiments together. In the whole 93 experiments averaged in the above table the coefficients for the availability of protein were 93.3 as found, against 93.6 as

calculated; the corresponding figures for the fats were 95.0 against 94.5, and for carbohydrates 97.7 against 98.1. These agreements seem to us to be reasonably close.

Table 5 gives a summary of the calculated availability of the different nutrients in 93 digestion experiments with the coefficients found by actual experiment.

TABLE 5.

Summary of comparison of coefficients of availability as found by actual experiment and as calculated by the proposed factors for availability.

No. Experiments Averaged.	Experiments.	Protein.		Fat.		Carbohydrates.	
		Found.	Calculated.	Found.	Calculated.	Found.	Calculated.
	At Middletown, Conn.	%	%	%	%	%	%
6	Metabolism experiments (1), 1896–7,	93.2	92.2	96.7	94.7	98.4	97.5
12	Preliminary to metabolism experiment (1), 1898–9, - - -	92.5	93.3	93.7	94.3	97.7	97.9
14	Metabolism experiments (1), 1898–9,	93.9	93.5	94.8	94.3	97.9	98.0
	At Knoxville, Tenn.						
9	Digestion and metabolism experiments (2), 1896–7, - -	93.9	93.8	94.6	94.6	97.2	98.1
23	Digestion and metabolism experiments (2), 1897–8, - -	94.4	93.8	96.2	94.6	97.4	98.2
24	Digestion and metabolism experiments (2), 1898–9, - -	92.3	94.0	94.9	94.4	97.8	98.3
5	Miscellaneous experiments (3), -	91.8	92.2	93.6	94.3	97.9	97.4
93	Average of all above experiments, -	**93.3**	**93.6**	**95.0**	**94.5**	**97.7**	**98.1**

(1) With men in respiration calorimeter.

(2) With men at work and without active muscular work.

(3) With men, Minneapolis, Minn., Knoxville, Tenn., and Middletown, Conn.

It may be that these figures by themselves give an exaggerated idea of the accuracy and value of such computations. There is more or less guess work in the method of estimating the coefficients of availability. It may be largely a matter of coincidence that these particular figures bring results agreeing so closely with those of actual experiment. It may be, for instance, that some of the coefficients of availability of individual nutrients of the different kinds of food materials are really wide of the mark and that the agreements which are so

close in these particular instances are due to an accidental balancing of errors. We do not assume that the coefficients of Table 4 represent the actual availability of the nutrients of the different kinds of food materials under all circumstances or in all of the food materials of any given class. It does seem to us, however, that such comparisons as those in Table 5 indicate that these coefficients represent a reasonably close approximation to the actual availability in the average mixed diet.

HEATS OF COMBUSTION OF NUTRIENTS.

The potential energy of any given substance is usually taken as equivalent to its heats of combustion determined by burning a known weight of the substance in oxygen. The actual amount of energy which the body can obtain from a given food material or diet depends upon various factors, the chief of which are the amounts and potential energy of the available nutrients of the food and the amount of incompletely oxidized material rejected in the urine.

The heats of combustion of a very large number of individual food materials have been determined, but the data concerning the heats of combustion of definite chemical compounds occurring in the food of man are much more limited. It is to Stohmann, Berthelot, and their associates that we are indebted for by far the greater part of the data now available, although within a few years a considerable number of determinations have been made in this country, mostly in connection with the nutrition investigations carried on under the auspices of the U. S. Department of Agriculture.*

HEATS OF COMBUSTION OF PROTEIDS, NON-PROTEIDS, AND PROTEIN OF FOOD MATERIALS.

The heat of combustion of different proteids varies within certain limits, but is in all cases much larger than that of the

* See summaries of results of these inquiries as given by Stohmann, U. S. Dept. Agr., Experiment Station Record, Vol. VI., p. 590; by Berthelot in Thermochimie, Vol. II., and by Atwater in Bulletin No. 21, U. S. Dept. Agr., Office of Experiment Stations.

It is expected that details of a compilation of the heats of combustion of different compounds and groups of compounds occurring in food materials will be published in the near future in a Bulletin of the Office of Experiment Stations.

more common non-proteids. The heat of combustion of the protein of any given food material will depend to some extent upon the kinds of proteids and of non-proteids which furnish the nitrogen from which the protein is estimated, but more especially upon the proportion in which these two classes of compounds occur, and unless we have direct data concerning the heat of combustion of the protein this value must be computed after much the same method as was adopted in estimating the nitrogen factor for protein (see pages 76–80).

The heat of combustion of fat-free muscular tissue, from which the extractives, *i. e.*, the non-proteids, have been removed, gives us a tolerably good idea of the potential energy of the protein of meats. The average value obtained for such protein is about 5.65 calories per gram. The heat of combustion of meat proteids appears to be noticeably higher, averaging not far from 5.75 calories per gram. Creatin may be taken as a type of the non-proteids of meats with a heat of combustion of 4.27 calories per gram. If we had satisfactory data concerning the proportions of creatin and other extractives in muscular tissues we could calculate the energy per gram of meat protein, but at present the heat of combustion of fat-free muscular tissue from which the extractives have not been removed gives us the most satisfactory value for this quantity. Concerning the heats of combustion of the proteids or protein of fish we have almost no data. It is assumed in this article that their heat of combustion is practically the same as that of the corresponding compounds in meats. Eggs are commonly assumed to have less of non-proteids than meats, and the heat of combustion would naturally be larger. The average heat of combustion of egg albumin appears to be about 5.70, and of protein of the nitrogenous matter of the yolk 5.80 calories per gram. It is probable, therefore, that the heat of combustion of the protein of egg is not far from 5.75 calories per gram. Concerning the heat of combustion of the protein of milk the data are somewhat conflicting. Casein as prepared in different ways has a heat of combustion of from 5.6 to 5.9 calories per gram. It has been assumed in the present article that the heat of combustion of milk protein is the same as that of muscular tissue, namely, 5.65 calories per gram.

The heats of combustion of vegetable proteids must be estimated largely from those of gluten, glutenin, gliadin, legumin, and plant fibrin, which are the principal proteid compounds of vegetable origin of which we find the heats of combustion reported.* Asparagin may be taken as a type of the non-proteids of vegetable foods, with a heat of combustion of 3.45 calories per gram. The heats of combustion of the protein of vegetable food materials will depend chiefly upon the proportions of proteids and non-proteids. In computing the heat of combustion of the protein of cereals we may assume 4 per cent. of the nitrogen of cereals as occurring in non-proteid compounds (see page 76). The proteids of cereal foods may be assumed to have a heat of combustion of not far from 5.9 calories per gram. In other words, about 96 per cent. of the weight of the protein of wheat flour, maize meal, buckwheat, etc., would have a total energy value of 5.9 calories per gram and the remaining 4 per cent. a value of 3.45 calories per gram. This would make the heat of combustion of one gram of protein of cereal food materials approximately 5.80 calories per gram.†

Concerning the heat of combustion of the dried legumes we have little information. Assuming that 96 per cent. of the nitrogen of the dried legumes is in proteid and 4 per cent. in non-proteid combination, and that the heat of combustion of the proteids is that of samples of legumin which have been burned in the bomb calorimeter, namely, 5.8 calories per gram, we may assume the heat of combustion of one gram of protein of these materials to be not far from 5.70 calories per gram.‡

* See Table 6.

† The details of the computations are as follows:

1 g. N. = .96 g. in proteids and .04 g. in non-proteids.
Then .96 x 5.70 = 5.47 g. proteids x 5.90 = - - - 32.3 calories,
and .04 x 4.70 = .19 g. non-proteids x 3.45 = - .6 calories,

or 5.66 g. protein = - - - - - 32.9 calories,
and 1.00 g. protein = 5.81 calories.

‡ The details of the computations are as follows:

1 g. N. = .96 g. in proteids and .04 g. in non-proteids.
Then .96 x 6.25 = 6.00 g. proteids x 5.80 = - - - 34.8 calories,
and .04 x 4.70 = .19 g. non-proteids x 3.45 = - .6 calories,

or 6.19 g. protein - - - - - 35.4 calories,
and 1.00 g. protein = 5.72 calories.

It has already been shown that the relative amount of non-proteids in the protein of vegetables and fruits is large. The potential energy of the protein of these foods is therefore relatively small owing to the low heat value of the non-proteids. Assuming 40 per cent. of the nitrogen in potatoes and other vegetables to exist in non-proteid compounds of which asparagin may be taken as the type, and 60 per cent. in proteids, with a heat of combustion of 5.8 calories per gram, the heat of combustion of one gram of vegetable protein or total nitrogenous matter would be about 5.00 calories.*

Since the nitrogenous matter of fruits appears to contain proportionately smaller amounts of the non-proteids than that of the vegetables, the heat of combustion of one gram of protein will be correspondingly greater. This heat of combustion may be computed upon the assumption that 30 per cent. of the nitrogen exists in non-proteid form of which asparagin may be taken as the type, and is approximately 5.20 calories per gram.†

In the following table are given the average heats of combustion per gram of some of the proteids and non-proteids and the computed values for protein of different groups of food materials.

* The details of the computations are as follows:

1 g. N. = .6 in proteids and .4 g. in non-proteids.
Then .6 x 6.25 = 3.75 g. proteids x 5.80 = - - 21.8 calories,
and .4 x 4.70 = 1.88 g. non-proteids x 3.45 = - 6.5 calories,
or 5.63 g. protein = - - - 28.3 calories,
and 1.00 g. protein = 5.03 calories.

† The details of the computations are as follows:

1 g. N. = .7 g. in proteids and .3 in non-proteids.
Then .7 x 6.25 = 4.38 g. proteids x 5.80 = - - 25.4 calories,
and .3 x 4.70 = 1.41 g. non-proteids x 3.45 = - 4.9 calories,
or 5.79 g. protein = - - - 30.3 calories,
and 1.00 g. protein = 5.23 calories.

TABLE 6.

Average determined heat of combustion of proteids and non-proteids and calculated heat of combustion of protein.

KIND OF MATERIAL.	HEAT OF COMBUSTION PER GRAM.	
	Determined.	Assumed or calculated.
	Calories.	Calories.
Beef, fat-free muscle,	5.65	—
Beef, fat-free muscle, extractives removed,	5.73	—
Veal, fat-free muscle,	5.65	—
Mutton, fat-free muscle,	5.60	—
Protein of meat,	—	5.65
Egg albumin,	5.71	—
Egg, protein of yolk,	5.84	—
Vitellin,	5.76	—
Protein of egg,	—	5.75
Milk casein,	5.63 to 5.86	—
Milk protein,	5.67	—
Protein of dairy products,	—	5.65
Gliadin,	5.92	—
Glutenin,	5.88	—
Gluten of wheat,	5.95	—
Legumin,	5.79	—
Plant fibrin,	5.89	—
Protein of cereals (96 % proteids),	—	5.80
Protein of legumes (96 % proteids),	—	5.70
Protein of vegetables (60 % proteids),	—	5.00
Protein of fruits (70 % proteids),	—	5.20
Gelatin,	5.27	—
Creatin, as type of non-proteids of animal foods,	4.27	—
Asparagin, as type of non-proteids of vegetable foods,	3.45	—

HEAT OF COMBUSTION OF FATS OF DIFFERENT FOOD MATERIALS.

In determining the amount of fat in a food material the substance is commonly extracted with ether. The ether extract, however, is apt to contain more or less material not actually fat and with a lower calorific value. On the other hand, with some food materials, *e. g.*, meats, with a large proportion of fat, the extraction by ether is sometimes incomplete, so that the fat obtained is less than the actual amount in the material.

The heat of combustion of the pure fats (triglycerids) of ordinary meats has been found to vary little from 9.5 calories per gram, while that of butter-fat averages not far from 9.25 calories per gram, and that of the fats and oils of ordinary vegetable foods about 9.3 calories per gram. The values for the

corresponding ether extracts are somewhat smaller. In estimating a factor for the heat of combustion of the fat in different kinds of food materials it may be assumed that the error introduced by the fact that ether extract represents other materials than fat which have a lower heat of combustion is offset by the incomplete extraction of fat, so that these two errors tend to compensate each other. In other words, taking the ether extract as a measure of the fat of food materials we may assume a heat of combustion of 9.5 calories per gram for all animal foods except dairy products, the heat of combustion of which appears to be about 9.25 calories per gram, while the vegetable fats and oils may be assumed to have a heat of combustion of 9.3 calories per gram.

The heats of combustion of different kinds of fats and oils as found by various observers and the factors here assumed for the fat of different groups of food materials are shown in Table 7.

TABLE 7.

Average determined heat of combustion of fats and oils and assumed factors for fat of different groups of food materials.

KIND OF MATERIAL.	HEAT OF COMBUSTION PER GRAM.	
	Determined.	Assumed or calculated.
	Calories.	Calories.
Beef fat,	9.50	—
Beef, "ether extract,"	9.24	—
Mutton fat,	9.51	—
Mutton, "ether extract,"	9.32	—
Pork fat,	9.50	—
Pork, "ether extract,"	9.13	—
Lard,	9.59	—
Cottolene,	9.32	—
Butter fat,	9.27	—
Wheat oil,	9.36	—
Wheat, "ether extract,"	9.07	—
Rye oil,	9.32	—
Rye, "ether extract,"	9.20	—
Maize oil,	9.28	—
Oats, "ether extract,"	8.93	—
Barley, "ether extract,"	9.07	—
Nut oil (except cocoanut),	9.49	—
Olive oil,	9.47	—
Cocoanut oil,	9.07	—
Fat of meat, fish, eggs, etc.,	—	9.50
Fat of dairy products,	—	9.25
Fat of cereals,	—	9.30
Fat of vegetables and fruits,	—	9.30

HEATS OF COMBUSTION OF CARBOHYDRATES OF DIFFERENT FOOD MATERIALS.

The ordinary meats and fish used for food contain very little of carbohydrates. Muscular tissue has a small quantity of glycogen, but in ordinary analyses it is usually not taken into account. As has already been stated, the protein as computed by the usual factor for animal foods (6.25) is probably slightly too large. On the other hand, the fuel value* of muscular tissue is not far different from that of glycogen. Hence the error involved in neglecting the glycogen in meats and fish as is ordinarily done is of little practical importance. The proportion of glycogen in the livers of animals used for food, and in oysters and other shell fish, is considerable. The amount of these food materials consumed in the ordinary diet is, however, relatively small. The heat of combustion of the glycogen can be taken at 4.2 calories per gram.

Milk contains a relatively large amount of milk sugar. The figures for heat of combustion of milk sugar now on record are not in agreement. We may take the factor 3.9 as most nearly representing the heat of combustion per gram of the carbohydrates of dairy products, and since in the ordinary diet the quantity of glycogen is relatively very small, this same factor (3.9) may be considered as an approximate average of the heats of combustion of all carbohydrates occurring in animal food materials.

The carbohydrates of the vegetable food materials consist largely of starch, sugar and fiber (cellulose), with smaller amounts of pentosans, dextrins, gums, etc. In flours and meals the carbohydrates consist almost entirely of starch. From the data available it seems probable that on the whole we shall not err greatly in assuming that 97 per cent. of the carbohydrates of cereal products is starch (and fiber), 2 per cent. dextrin, and 1 per cent. sugar. While the fiber is not as digestible as the starch, and would therefore not have as high fuel value, it occurs in such small quantities as to be of little importance in the cereal products as ordinarily used for the food of man.

The heat of combustion of starch (and fiber or cellulose) is about 4.2, that of dextrin 4.1, and that of cane sugar 3.96

* See p. 96, *et seq.*

calories per gram. Since the heat of combustion of dextrin and sugar is not greatly different from that of starch, and the amount in the cereal food materials relatively small in amount, the heat of combustion of the carbohydrates of these materials may be taken at 4.2 calories per gram.

The carbohydrates of the ripe seeds of the legumes like those of the cereals consist very largely of starch with more or less fiber, and the heat of combustion is here taken as 4.2 calories per gram. The food materials consisting largely of starch, such as corn starch, tapioca, etc., may also be assumed to have a similar heat of combustion per gram of carbohydrates.

The heat of combustion of the glucoses averages not far from 3.75 and of sucrose 3.96 calories per gram. It is here assumed that the heat of combustion of cane sugar, and the sugars of sirup, molasses, etc., may be taken as 3.95 calories per gram.

The carbohydrates of vegetables such as potatoes, turnips, squash, etc., consist very largely of starch and cellulose with more or less sugars. The quantity of sugar in beets and parsnips is considerable, that in potatoes and turnips insignificant in amount. There is probably a larger proportion of pentosans in the carbohydrates of vegetables than in that of the cereals. The heat of combustion of the pentosans appears to be rather higher than that of the polyhexoses, and may perhaps offset the lower heat of combustion of the sugars. In lack of more definite data it is here assumed that the average heat of combustion of one gram of carbohydrates of vegetables is, like that of cereals and legumes, 4.2 calories per gram.

When we come to consider the carbohydrates of fruits, however, allowance must be made for the large proportion of sugars chiefly dextrose and levulose, the heats of combustion of which are considerably smaller than of the starches. There are at the same time certain amounts of starch, pentosans and cellulose, which tend to increase the heats of combustion of the mixed carbohydrates of fruits. In the light of these considerations it would seem that the average heat of combustion of the carbohydrates occurring in fruits might be not far from 4.0 calories per gram.

In the following table the heats of combustion of some of the principal kinds of carbohydrates and the values here assumed for the carbohydrates of different kinds of food materials are

tabulated. It is of course to be understood that these factors, like those for protein and fats, are simply tentative, based upon the best data we have been able to obtain.

TABLE 8.

Average determined heats of combustion of different carbohydrates and assumed factors for carbohydrates of different groups of food materials.

KIND OF MATERIAL.	HEAT OF COMBUSTION PER GRAM.	
	Determined.	Assumed or calculated.
	Calories.	Calories.
Pentoses,	3.72 to 4.38	—
Dextrose,	3.75	—
Levulose,	3.76	—
Cane sugar,	3.96	—
Milk sugar,	3.86	—
Cellulose,	4.20	—
Starch,	4.20	—
Dextrin,	4.11	—
Glycogen,	4.19	—
Carbohydrates of animal foods, meats, dairy products, etc.,	—	3.90
Carbohydrates of cereals,	—	4.20
Carbohydrates of legumes,	—	4.20
Sugars,	—	3.95
Starches,	—	4.20
Carbohydrates of vegetables,	—	4.20
Carbohydrates of fruits,	—	4.00

TESTS OF ACCURACY OF PROPOSED FACTORS FOR HEATS OF COMBUSTION.

The figures of Tables 6, 7, and 8, taken in connection with the percentage composition of any given food material, enable us to compute its heat of combustion. If the heat of combustion has been actually determined by the bomb calorimeter it gives a means of testing the accuracy of the factors thus assumed. Many analyses of food materials in which the heat of combustion was determined are available for this purpose. A large portion of these have been made in connection with the investigations upon the food and nutrition of man carried on under the auspices of the United States Department of Agriculture, in coöperation with this and other experiment stations and educational institutions. Table 9 shows the computed and determined heat of combustion in 276 samples of food materials, 220 of which were analyzed in this laboratory and the remainder by Prof. Grindley of the University of Illinois.

The number of analyses in this comparison might be largely increased, but it is believed that a sufficient number have been taken to show the agreement between the computed and determined values. The method of computing the heat of combustion of the different materials was as follows: In a sample of wheat bread, for example, the water-free substance contained 14.8 per cent. protein, 2.9 per cent. fat, and 80.2 per cent. carbohydrates, and had a heat of combustion, as actually determined, of 4.529 calories per gram. One gram of the water-free material contains, therefore, .148, .029, and .802 grams of protein, fats, and carbohydrates respectively, and its heat of combustion as computed from the factors given in Tables 6, 7, and 8 would be $(.149 \times 5.80 + .029 \times 9.30 + .802 \times 4.20 =)$ 4,502 calories per gram. All of the comparisons have been made on the basis of the water-free material.

TABLE 9.

Comparison of heats of combustion as calculated by use of the above factors with results found by actual experiment.

KIND OF FOOD MATERIAL.	Number of analyses included in average.	AVG. HEAT OF COMBUSTION PER GRAM OF WATER-FREE SUBSTANCE.		Calculated results in percentages of those determined.
		Determined.	Calculated.	
		Calories.	Calories.	%
Beef,	55	6507	6619	101.7
Beef, canned,	7	6197	6268	101.2
Mutton,	10	7146	7316	102.4
Pork,	10	7835	7944	101.4
Poultry,	5	6310	6508	103.1
Fish,	3	6317	6427	101.8
Eggs,	10	7103	7160	100.8
Butter,	20	8832	8918	101.0
Milk,	37	5437	5413	99.6
Breakfast foods,	3	4367	4360	99.8
Bread, crackers, etc.,	36	4536	4513	99.5
Corn (maize) meal and corn preparations,	7	4580	4624	101.0
Rye preparations,	6	4353	4343	99.8
Barley preparations,	2	4352	4365	100.3
Rice,	5	4390	4474	101.9
Oatmeal (rolled oats),	2	4834	4811	99.5
Oatmeal, cooked,	6	4488	4480	99.8
Wheat, pastry,	8	4579	4605	100.6
Legumes, fresh,	8	4367	4361	99.9
Legumes, cooked,	5	4312	4343	100.7
Vegetables, fresh,	10	4195	4051	96.6
Vegetables, cooked,	3	4057	4277	105.4
Vegetables, canned,	2	4264	4102	96.2
Fruits, fresh,	12	4389	4123	93.9
Fruits, canned,	4	4078	4056	99.5
Average 276 samples,	—	—	—	100.3

There were at times quite marked variations between the heats of combustion actually found and those calculated, amounting in some cases to as much as 5 or even 6 per cent. of the former value. On the whole, however, the agreement is as close as could well be expected when we consider the relatively small amount of data upon which some of the assumptions involved in deriving the factors are based, and when we consider, on the other hand, the possibility of errors in the chemical analyses. Indeed, it seems to us that the agreement in a large number of cases has been sufficiently close to warrant the use of these factors as a check on the analytical work or on the determinations of the actual heats of combustion by means of the bomb calorimeter. Thus if marked discrepancies occur in any given case between the calculated heats of combustion and those determined by the bomb calorimeter, either the analytical work may well be repeated or the heat of combustion redetermined or both. Of course in some prepared foods made up of several different kinds of food materials, pastries for example, which contain an unknown proportion of sugars and starches, the calculated heat of combustion may differ considerably from the computed, and cannot be used as giving any check upon the analytical results.

FUEL VALUE.

In accordance with the definitions in the previous article (see pages 69–72) the fuel value of a given food material is measured by the difference between its heat of combustion and the heats of combustion of the corresponding feces and urine. It is assumed that under normal conditions the fats and carbohydrates are completely oxidized in the body, and that hence their fuel values will be their total heats of combustion less those of the unavailable portions; in other words, the heats of combustion of the available portions. It is also assumed that all of the energy yielding material of the urine comes from the incomplete oxidation of the protein of the food. The heat of combustion of protein as determined with the bomb calorimeter measures the heat evolved in the complete oxidation of the carbon to carbon dioxide, and the hydrogen to water, while the nitrogen remains in the free state. In the body, however, oxidation of nitrogenous compounds cannot be carried as far and the

nitrogen is excreted in the form of urea, uric acid, and allied compounds. The carbon and hydrogen, however, appear to be oxidized completely to carbon dioxide and water with the exception of the small amounts in combination with the nitrogen in the urine. The urine also contains a small amount of non-nitrogenous organic material, part of which may not improbably be derived from the digested fats and carbohydrates of the food. It is customary, however, to consider the heat of combustion of the urine as representing that portion of the energy of the protein which is broken down which the body cannot utilize. In other words, we assume that the total potential energy of the available fats and carbohydrates is itself available for use in the body while only a portion, although the major portion, of the energy in the available protein is thus available.

This brings out the distinction between the availability of the material and of the energy belonging to it. In speaking of the available material we refer to the portion which is digested and absorbed less the corresponding metabolic products which are eliminated with the undigested residue, and are regarded as required for the process of digestion. The available energy of the fats and carbohydrates is the total energy of their available material. In the case of protein, however, the available material is not fully oxidized, and the available energy is the total less that of the material which escapes oxidation. The last statement requires qualification, because it does not distinguish between the proteids and non-proteids of the protein. To be strictly accurate we should have to consider the proteids themselves, determine their amounts, availability and heats of combustion, and also learn by some means how much of their energy is transformed in the body by oxidation and how much is left in the residues excreted in the urine. The different classes of non-proteids could be treated in like manner. Our present knowledge, however, does not permit such determinations, nor are the experimental methods by which they should be made as yet sufficiently elaborated.

The best we are able to do at present is to determine as nearly as practicable the proportions of protein which are actually available and the heat of combustion of the material in the urine which is assumed to come from the incomplete oxidation of the protein compounds.

We measure the protein by multiplying the nitrogen by a given factor which varies with different food materials. The factor for computing the total protein of a given diet is decided by the proportions of the different food materials and their several nitrogen factors. We assume that the nitrogen factor is the same for the available protein as for the corresponding total protein. It may be that later inquiry will show that this assumption is incorrect, but in lack of more accurate knowledge we can do no better than follow the present plan.

The heat of combustion of the water-free substance of the urine is determined by the usual method of oxidation by means of the bomb calorimeter and can be compared with the corresponding nitrogen of the urine, thus showing the ratio of nitrogen to the heat of combustion. A similar ratio of nitrogen to heat of combustion of protein could be established if necessary.

A considerable amount of experimental data has accumulated in this laboratory within the past few years concerning this ratio of nitrogen to energy in the urine. A few like determinations* have been made by Prof. Chas. D. Woods, formerly of this Station and now Director of the Maine Experiment Station. As the average of forty-six determinations of this ratio it was found that for every gram of nitrogen in the urine there was unoxidized material sufficient to yield 7.9 calories of energy. On the assumption already made that all the energy in the urine is derived from incompletely oxidized available protein, we may substitute for the ratio of nitrogen to energy the ratio of available protein to energy. This value is found in the following manner: One gram of nitrogen in the urine is assumed to represent the breaking down or catabolism of 6.25 grams of available protein of food or of body protein. This assumption is slightly inaccurate owing to the presence in the food of some proteids, such as those of wheat and rye, and more especially the non-proteids containing more than 16 per cent. of nitrogen. It does, however, come close to the truth. For every 6.25 grams of protein consumed, therefore, there would be 7.9 calories of energy in the unoxidized materials of the urine, or about 1.25 calories per gram ($7.9 \div 6.25 = 1.26$).

* Unpublished.

Using the figures for availability and heat of combustion of protein compounds given in Table 4 (page 86) and Table 6 (page 92), and the factor 1.25 as expressing the amount of energy lost in the urine per gram of available protein, the calculation of the fuel value of protein is simple. We may take for instance the protein of meat. This is assumed to have a heat of combustion of 5.65 calories per gram. Ninety-seven per cent. of this protein is rendered available for use in the body; the total energy of the available protein corresponding to 1 gram of total protein would be 5.5 calories ($5.65 \times .97 = 5.48$). Of this 5.5 calories, however, 1.25 calories will be contained in the incompletely oxidized material of the urine, so that the actual amount of energy obtained by the body from the gram of protein eaten is equal to 4.25 calories ($5.65 \times .97 - 1.25 = 4.23$). In other words, on the basis of the previous assumption the fuel value of 1 gram of protein of meat is 4.25 calories per gram. In a similar manner we may calculate the fuel value of 1 gram of protein of cereals. The heat of combustion per gram is approximately 5.8 calories, and 85 per cent. of the protein appears to be available for use in the body. But for every gram of protein thus available not far from 1.25 calories of energy is lost in the urine. The fuel value, therefore, of 1 gram of protein of cereals as thus computed is 3.7 calories ($5.80 \times .85 - 1.25 = 3.68$). Similar computations give factors for fuel value of protein of eggs, dairy products, legumes, vegetables and fruits. The results of these calculations are shown in Table 10 beyond.

In determining factors for fuel value of fats and carbohydrates we have to consider only the total energy and the proportion actually available, since we assume that none of the energy of these nutrients is lost in the urine. It appears, for example, that 95 per cent. of the fat of meat is utilized within the body. The average heat of combustion of 1 gram of meat fat is 9.5 calories, and the energy of the available material, which for fats is the same as its fuel value, would therefore be 9 calories per gram ($9.5 \times .95 = 9.02$). In a similar manner the fuel value of the carbohydrates is found by deducting the energy in the unavailable portion from the total energy. The heat of combustion of 1 gram of carbohydrates of cereals, for example,

is 4.2 calories, and 98 per cent. is available. Accordingly the factor for 1 gram would be 4.1 calories ($4.2 \times .98 = 4.12$).

In Table 10 beyond are summarized the factors for fuel value of nutrients in different groups of food materials, together with factors for heats of combustion, availability, etc. The method of deriving the quantities in the different columns is in part indicated by algebraic expressions in the column headings. The quantities in column A represent in round numbers the approximate proportion of the different nutrients found in each of the different groups of food materials in the average diet as based upon the results obtained in an examination of 185 actual dietary studies. The figures are essentially the same as those given in Table 3 above. The figures in column B are taken from Tables 6, 7 and 8 above, and represent the factors for the heat of combustion or total energy per gram of the nutrients in the different groups of food materials. In computing the figures for the heats of combustion of total animal food, total vegetable food, and total food in the average mixed diet, account is taken of the proportional amounts of the nutrients furnished by the different groups of food materials as shown in column A and the heat of combustion of these nutrients as shown in column B. For example, in the ordinary mixed diet about 43 grams out of every 100 of protein is furnished by meat, fish, etc. This 43 grams, with a heat of combustion of 5.65 calories per gram, supplies a total energy of 243.0 calories ($43 \times 5.65 = 243$). In the same diet 6 grams of protein would come from eggs. This, at 5.75 calories per gram, furnishes 34.5 calories. The dairy products furnish 12 grams of protein, with a heat of combustion of 5.65 calories per gram, making 67.8 calories. The total animal food thus supplies ($43 + 6 + 12 =$) 61 grams of the 100 grams of the whole diet, and these 61 grams of animal protein contain a total of ($243 + 34.5 + 67.8 =$) 345.3 calories, which are equal to ($345.3 + 61 = 5.651$) 5.65 calories per gram. In like manner the 39 grams of vegetable protein are made up of 31 grams of protein from cereals with a heat of combustion of 5.80 calories per gram; 2 grams from legumes with a heat of combustion of 5.70; 5.5 grams from vegetables with a heat of combustion of 5.00; and .5 of a gram from fruit with a heat of combustion of 5.20 calories per gram. We thus have 421.3 calories

furnished by the 39 grams of vegetable protein, or 5.65 calories per gram. Both the animal and the vegetable protein average approximately 5.65 calories per gram, which is therefore the average heat of combustion of the total protein of the diet.

In a similar manner we may compute the average heat of combustion of the fats and carbohydrates in mixed diet. Out of every 100 grams of total carbohydrates 95 are obtained from the vegetable food materials, with a total heat of combustion of 392.8 calories. The heat of combustion per gram therefore amounts to $(392.8 \div 95 =)$ 4.135 calories, or approximately 4.15 calories per gram. The animal carbohydrates with a heat of combustion of 3.90 calories per gram furnish $(3.90 \times 5 =)$ 19.5 calories of energy, making the total heat of combustion of 100 grams of carbohydrates in mixed diet $(392.8 + 19.5 =)$ 412.3 calories, or approximately 4.15 calories per gram.

The factors for total animal food, total vegetable food and total food in the remaining columns of Table 10 are obtained in a manner similar to that just described.

In what has been said regarding the available energy of the different nutrients in different classes of food materials reference was made to the fuel value per gram of total protein, fats, or carbohydrates. The figures in the last column of Table 10 give the factors representing these fuel values. It may frequently occur, however, that corresponding factors are needed for the fuel value of one gram of available protein, fats, or carbohydrates. The potential energy of one gram of available protein is assumed to be the same as that of one gram of total protein. In other words, it is assumed that the energy of one gram of available is the same as that of one gram of unavailable protein. While this may not be strictly true, there is little or no experimental evidence warranting any other supposition. It follows, therefore, that the fuel value of one gram of available protein is its heat of combustion less 1.25 calories —the energy lost in the urine. If, as has been assumed, none of the potential energy of its available fats and carbohydrates is lost in the organic matter of the urine, then the fuel value of one gram of available fats or carbohydrates will be the same as its heat of combustion, or as the heat of combustion of one gram of corresponding material of total food. These factors

for fuel value per gram of available nutrients are given in the next to the last column of Table 10.

TABLE 10.

Factors for heats of combustion and fuel values of nutrients in different groups of food materials and in mixed diet.

KIND OF FOOD MATERIAL.	Nutrients furnished by each group per 100 grams total.	Heat of combustion per gram.	Proportion of total nutrients actually available.	Total energy per gram in available nutrients.	FUEL VALUE.	
					Per gram available nutrients.	Per gram total nutrients.
	A	B	C	D =B x C	E*	F†
Protein.	Grams.	Cal.	%	Cal.	Cal.	Cal.
Meats, fish, etc.,	43.0	5.65	.97	5.50	4.40	4.25
Eggs,	6.0	5.75	.97	5.60	4.50	4.35
Dairy products,	12.0	5.65	.97	5.50	4.40	4.25
Animal food,	61.0	5.65	.97	5.50	4.40	4.25
Cereals,	31.0	5.80	.85	4.95	4.55	3.70
Legumes,	2.0	5.70	.78	4.45	4.45	3.20
Vegetables,	5.5	5.00	.83	4.15	3.75	2.90
Fruits,	0.5	5.20	.85	4.40	3.95	3.15
Vegetable food,	39.0	5.65	.85	4.80	4.40	3.55
Total food,	100.0	5.65	.92	5.20	4.40	4.00
Fat.						
Meat and eggs,	60.0	9.50	.95	9.00	9.50	9.00
Dairy products,	32.0	9.25	.95	8.80	9.25	8.80
Animal food,	92.0	9.40	.95	8.95	9.40	8.95
Vegetable food,	8.0	9.30	.90	8.35	9.30	8.35
Total food,	100.0	9.40	.95	8.90	9.40	8.90
Carbohydrates.						
Animal food,	5.0	3.90	.98	3.80	3.90	3.80
Cereals,	55.0	4.20	.98	4.10	4.20	4.10
Legumes,	1.0	4.20	.97	4.05	4.20	4.05
Vegetables,	13.0	4.20	.95	4.00	4.20	4.00
Fruits,	5.0	4.00	.90	3.60	4.00	3.60
Sugars,	21.0	3.95	.98	3.85	3.95	3.85
Vegetable food,	95.0	4.15	.97	4.00	4.15	4.00
Total food,	100.0	4.15	.97	4.00	4.15	4.00

* Values for fats and carbohydrates, same as corresponding values in column B. Values for protein, same as corresponding values in column B minus 1.25.

† Values for fats and carbohydrates, same as corresponding values in column D. Values for protein, same as corresponding values in column D minus 1.25.

The factors for fuel value in Table 10 represent the available energy per gram. Corresponding values per pound can be readily computed by multiplying the values per gram by 453.6, the number of grams in a pound. In the ordinary mixed diet the fuel value of one pound of protein as thus computed from the figures of Table 10 is 1,820, of fat 4,040, and of carbohydrates 1,820 calories. The corresponding values per pound of available nutrients are 2,000, 4,260, and 1,860 calories respectively.

APPLICATION OF PROPOSED FACTORS FOR FUEL VALUE TO ACTUAL DIGESTION EXPERIMENTS.

In the preceding pages the factors for availability and for heats of combustion have been applied to experimental data in such a way as to test their accuracy. In a similar manner the reliability of the proposed factors for fuel value may be tested by applying them to the quantities of nutrients consumed in digestion experiments with mixed diet of more or less simple character, and comparing the computed fuel value of the diet with that actually found by experiment, *i. e.*, the difference between the total energy of the food and that of the feces and urine.

The results of a considerable number of digestion experiments are available for the purpose of such comparison. Thus far we have made the necessary calculations from the data of twenty-seven experiments carried on in this laboratory in connection with investigations with the respiration calorimeter.* In some of these the subject was outside the respiration apparatus, the study being preliminary to the more detailed experiments within the respiration chamber. These are indicated in Table 11 beyond as "ordinary" experiments. In other experiments the subject was in the apparatus. These are indicated as "respiration" experiments. Each "ordinary" experiment was immediately followed by one or more "respiration" experiments with the same man. The kinds and amounts of food in the "ordinary" or preliminary experiments were very nearly the same as in the subsequent "respiration" experiments.

* The details of the digestion experiments are to be published in a Bulletin of the Office of Experiment Stations of the U. S. Department of Agriculture.

The data of these digestion experiments serve for making a comparison not only of the fuel values as computed and as actually found by experiment, but also of the total energy as computed and as actually determined. In making these computations the quantities of protein, fats, and carbohydrates furnished by the different nutrients consumed were multiplied by the corresponding factors for heats of combustion and for fuel values, and thus the total computed energy and fuel value of the diet was found. The proportion which the calculated values bear to the corresponding values as actually determined was then computed. Thus in digestion experiment No. 37, 1,165 grams of meat were consumed, furnishing 326 grams of protein and 69 grams of fat. The heat of combustion of the protein of meat was assumed to be 5.65 calories per gram and of fat 9.5 calories per gram. The heat of combustion as calculated thus amounts to 2,497 calories ($326 \times 5.65 + 69 \times 9.5 = 2,497$). The fuel value of the 326 grams of protein and 69 grams of fat was found by multiplying by the factors 4.25 and 9.00 respectively, and amounts to 2,007 calories ($326 \times 4.25 + 69 \times 9.0 = 2,007$). In a similar manner the heat of combustion and fuel value of the other foods used were calculated. The total heat of combustion of the diet as calculated amounted to 21,763 calories, while the actual determination by means of the bomb calorimeter showed 21,467 calories. The calculated value was thus 101.4 per cent. of that actually determined. The fuel value of the diet as calculated amounted to 19,559 calories, while the amount of energy actually made available in this experiment was 19,299 calories. The calculated fuel value was thus 101.4 per cent. of the fuel value actually found by experiment.

The results of these comparisons are shown in Table 11 on the following page. It is of considerable interest to note that in the twenty-seven experiments compared in this table the maximum variation between the heat of combustion as calculated and as found amounts to but 2.5 per cent. of the latter value, while the average values are identical. At the same time the fuel value as calculated ranges from 3.1 per cent. above to 2.1 per cent. below that actually found by experiment, the average difference in twenty-seven experiments being but one part in a thousand. This close agreement between the computed values

and those actually found by experiment may of course be due to compensation of errors, and when a large number of experiments are compared in the same way the results may prove less strikingly concordant, but it seems hardly probable that the proposed factors for heats of combustion and fuel value can be very far out of the way.

TABLE 11.

Comparison of heats of combustion and fuel values of nutrients of food consumed in digestion experiments as calculated by use of the proposed factors and as found by experiment.

No. of experiment.	Character of Experiment.*	Heats of combustion calculated in per cent. of that actually found.	Fuel value calculated in per cent. of that actually found.	No. of experiment.	Character of Experiment.*	Heats of combustion calculated in per cent. of that actually found.	Fuel value calculated in per cent. of that actually found.
		%	%			%	%
37	Ordinary, -	101.4	101.4	51	Ordinary, -	100.4	101.4
38	Respiration, -	101.2	101.8	52	Respiration, -	99.9	99.3
39	Ordinary, -	99.3	98.1	76	Ordinary, -	100.7	98.8
40	Respiration, -	99.4	97.9	77	Respiration, -	99.9	100.3
41	Ordinary, -	102.1	103.1	78	Ordinary, -	99.1	99.2
42	Respiration, -	102.5	100.2	79	Respiration, -	99.4	98.9
43	Ordinary, -	99.7	100.3	80	Ordinary, -	98.9	99.4
44	Respiration, -	99.8	99.0	81	Respiration, -	98.7	98.9
45	Ordinary, -	100.2	103.1	82	Ordinary, -	99.3	99.0
46	Respiration, -	100.2	101.7	83	Respiration, -	99.4	99.2
47	Ordinary, -	100.7	100.7	84	Ordinary, -	98.5	98.3
48	Respiration, -	100.6	102.0	85a	Respiration, -	98.7	98.6
49	Ordinary, -	101.0	101.8	85b	Respiration, -	98.6	98.9
50	Respiration, -	101.0	102.4		Avg. 27 expts.	**100.0**	**100.1**

* These twenty-seven experiments were made in connection with investigations with the respiration calorimeter. Those marked "ordinary" were conducted outside the apparatus, and immediately preceded the respective "respiration" experiments in which the subject was inside the respiration chamber.

COMPARISON OF FACTORS HERE PROPOSED WITH THOSE PROPOSED BY RUBNER.

The factors for fuel value now in most common use are those proposed by Rubner,† in 1885. This investigator assigns 4.1 calories per gram to the protein, 9.3 to the fats, and 4.1 to the carbohydrates of ordinary mixed diet.

† Ztschr. Biol., 21 (1885), p. 377.

In the estimates upon which these figures are based Rubner made use of the heats of combustion of the compounds of the different classes of nutrients in so far as they were available at the time. For the potential energy of the material excreted in the urine he used the results of determinations of the nitrogen and heats of combustion of the water-free substance of the urine of dogs with a diet of meat. He assumed that 60 per cent. of the protein of ordinary mixed diet was of animal and 40 per cent. of vegetable origin. He made allowance for the energy in the feces as determined by experiments with dogs on a meat diet, but made no allowance for any undigested residue of the fats and carbohydrates of the food. To state the case in another way, he assumed the fuel value ("Wärmewerth") of the fats and carbohydrates to be the same as their heats of combustion, but estimated the similar factors for the protein by subtracting the heat of combustion of feces and urine from the total heat of combustion of the protein of the food. Considering the paucity of his data and the fact that he made no allowance for either the undigested material or the metabolic products of the feces properly belonging to the carbohydrates and fats, the results are certainly very close to those to which we are led by the use of the more extensive data now available. The closeness of this agreement appears to be partially due to a balancing of errors. The heats of combustion which Rubner used were largely those determined by means of the Thompson-Stohmann calorimeter, which gave rather too low results. We hope to discuss this subject more fully in a later article.

SUMMARY.

The object of the preceding discussion is to deduce factors for estimating the nutritive values of materials used for the food of man.

The principal data used for these estimations are the percentages, coefficients of availability, heats of combustion, and fuel values of the protein, fats, and carbohydrates in food materials and the proportional amounts of different kinds of foods used in the average diet. The proportions of nutrients in ordinary food are found by analysis. There are now available analyses of not

far from 4,000 specimens of American food materials. In estimating the proportion of nutrients in ordinary mixed diet, the results of 185 studies of actual dietaries were employed. These studies have been made in different parts of the United States, mostly within the past ten years; some by persons connected with this Station, but the larger number by other investigators engaged in the coöperative inquiry under the auspices of the U. S. Department of Agriculture, of which the work here reported may be said to form a part. The coefficients of availability are based largely upon the results of digestion experiments with men. These belong to the coöperative inquiry just referred to, and a considerable number were made by this Station. The data for heats of combustion have been compiled from various sources, and included results obtained in this laboratory. The factor for the heat of combustion of the unoxidized material of the urine is based upon the results of the examination of 46 specimens of urine of healthy men with mixed diet. These results were mostly obtained in this laboratory in connection with digestion and metabolism experiments.*

The outcome of these estimates may be stated as follows:

Taking into account (1) the heats of combustion of the protein compounds, fats and carbohydrates which occur in different groups of food materials, and (2) the average proportion in which the different nutrients are furnished by different food materials in the ordinary mixed diet, the average heat of combustion of one gram of protein, fat and carbohydrates in such diet is approximately 5.65, 9.40 and 4.10 calories respectively.

The results of a considerable number of digestion experiments with mixed diet give averages for coefficients of availability as follows: For protein 92 per cent., fats 95 per cent., and carbohydrates 97 per cent.

One gram of total protein of mixed diet burned in the body yields on the average not far from 4.0 calories, one gram of fat 8.9 calories, and one gram of carbohydrates 4.0 calories of energy. The corresponding values per pound are 1,820, 4,240 and 1,820 calories. One gram of available protein on the other hand has a fuel value of 4.4 calories, one gram of available fats 9.4 calories, and one gram of available carbohydrates 4.1 calories. These values correspond to 2,000, 4,260 and 1,860 calories per gram.

* See second foot-note on p. 111.

The following table summarizes the various factors for nutrients of mixed diet:

TABLE 12.

Factors for heats of combustion, availability and fuel values of nutrients in mixed diet.

KIND OF MATERIAL.	Heat of combustion per gram.	Availability.	FUEL VALUE.			
			Referred to available nutrients.		Referred to total nutrients.	
			Per gram.	Per lb.	Per gram.	Per lb.
	Cal.	%	Cal.	Cal.	Cal.	Cal.
Protein, - - - -	5.65	92	4.4	2000	4.0	1820
Fats, - - - - -	9.40	95	9.4	4260	8.9	4040
Carbohydrates, - - -	4.10	97	4.1	1860	4.0	1820

Of course these figures are not to be regarded as final, and alterations may be called for as data accumulate. Meanwhile we think that they are sufficiently accurate for ordinary use.

COMPOSITION OF COMMON FOOD MATERIALS— AVAILABLE NUTRIENTS AND FUEL VALUE.

BY W. O. ATWATER AND A. P. BRYANT.

Previous reports of this Station have contained tables of average composition of food materials. In these tables, with one exception,* no attempt was made to show the actual amounts and fuel values of the nutrients which are available for use in the body. These may, however, be computed by use of the data given and the conclusions reached in the preceding article. Thus, by the application of the factors for availability given in Table 12, on page 110, we may compute the actual proportions of available and unavailable nutrients in different food materials, and by means of the factors given in the same table for the fuel value of protein, fats, and carbohydrates in different groups of food materials, we may compute the actual amounts of energy which they yield to the body.

In the following table the figures for percentage composition of the different food materials were taken from a compilation made by the writers of over 4,000 analyses of American food materials, of which nearly 1,000 were made in this laboratory.† The table shows the proportions of available nutrients, and the available energy per pound in each of a considerable number of food materials, as computed from the data mentioned above. In such food materials as contain refuse the composition of the material both with and without refuse is given. Take for example beef brisket. The edible portion (e. p.) of this contains, as the average of the analyses now accessible, 54.6 per cent. of water, 15.8 per cent. protein (N. × 6.25), 28.5 per cent. fat, and .9 per cent. mineral matter or ash.

* Report of Storrs Experiment Station, 1896, p. 202.

† See U. S. Department of Agriculture, Office of Experiment Stations, Bulletin 28, Revised, The Chemical Composition of American Food Materials. By W. O. Atwater and A. P. Bryant.

Taking 97 per cent. of the protein, 95 per cent. of the fat, and 75* per cent. of the ash as available for use in the body (see Table 4) the composition of beef brisket may be given as follows: Water, 54.6 per cent.; unavailable nutrients, 2.1 per cent.; available protein, 15.3 per cent. (15.8 × .97); available fat, 27.1 (28.5 × .95); and available mineral matter, .7 per cent. (.9 × .75). The fuel value of one pound of this meat would then be calculated by use of the factors given in Table 10, page 104. In one gram of the material there is actually available to the body .153 grams of protein, the fuel value of which is (.153 × 4.4 =) .673 calories, and .271 gram of fat with a fuel value of (.271 × 9.5 =) 2.575 calories, making a total fuel value of 3.248 calories per gram. To obtain the corresponding value per pound we multiply the value per gram by the number of grams in one pound (453.6). The fuel value of one pound of the brisket is therefore (3.248 × 453.6 = 1,473) 1,475 calories.

Unless otherwise stated the figures in the following table apply to materials of average composition. There are at times wide variations in the proportion of fat in meat from the same cut, *e. g.*, beef round. Indeed, the leaner cuts from a fat animal may be as fat as the fatter cuts from a lean animal. This variation in the composition of similar portions of a lean, medium fat and fat animal is illustrated by a few examples in the following table.

When the material as ordinarily found in the market contains refuse such as bone, tendon, shell, skin, seeds, etc., the composition of both the edible material and of the material as purchased is usually given. The former is designated by the letters e. p., the latter by the letters a. p. In such food materials as ordinarily contain no refuse the composition of the edible material is identical with that of the material as purchased, and the letters e. p. and a. p. are omitted in the table.

* In lack of satisfactory data, it is here assumed that 75 per cent. of the mineral matters of different food materials is available.

TABLE 13.

Composition of ordinary food materials.

a. p. = as purchased. e. p. = edible portion. See page 112.

KIND OF FOOD MATERIAL.		Refuse.	Water.	Unavailable nutrients.	AVAILABLE NUTRIENTS.				Fuel value per lb.
					Protein.	Fat.	Carbohydrates.	Ash.	
ANIMAL FOODS. *Beef (fresh).*		%	%	%	%	%	%	%	Calories.
Brisket,	e. p.,	—	54.6	2.1	15.3	27.1	—	.7	1475
	a. p.,	23.3	41.6	1.6	11.6	21.2	—	.5	1145
Chuck,	e. p.,	—	62.7	1.8	17.9	17.1	—	.7	1095
	a. p.,	16.3	52.6	1.4	15.0	14.3	—	.6	915
Flank,	e. p.,	—	60.2	1.9	18.3	19.9	—	.7	1225
	a. p.,	10.2	54.0	1.7	16.5	18.0	—	.5	1105
Loin, lean,	e. p.,	—	67.0	1.2	19.1	12.1	—	1.0	900
	a. p.,	13.1	58.2	1.1	16.6	10.5	—	.9	785
Loin, medium,	e. p.,	—	60.6	1.8	17.9	19.2	—	.8	1185
	a. p.,	13.3	52.5	1.6	15.6	16.6	—	.7	1025
Loin, fat,	e. p.,	—	54.7	1.9	17.0	26.2	—	.9	1470
	a. p.,	10.2	49.2	1.8	15.2	23.6	—	.8	1320
Neck,	e. p.,	—	63.4	1.6	19.5	15.7	—	.7	1065
	a. p.,	27.6	45.9	1.2	14.1	11.3	—	.5	770
Plate,	e. p.,	—	54.4	2.2	16.0	27.6	—	.6	1510
	a. p.,	16.5	45.3	1.8	13.4	23.2	—	.5	1265
Ribs,	e. p.,	—	55.5	2.0	17.0	25.3	—	.7	1430
	a. p.,	20.8	43.8	1.8	13.5	20.0	—	.5	1130
Round, lean,	e. p.,	—	70.0	1.0	20.7	7.5	—	1.1	735
	a. p.,	8.1	64.4	1.0	18.9	6.9	—	1.0	675
Round, medium,	e. p.,	—	65.5	1.6	19.7	12.9	—	.8	950
	a. p.,	7.2	60.7	1.4	18.4	12.2	—	.8	895
Round, fat,	e. p.,	—	60.4	1.6	18.9	18.5	—	1.0	1175
	a. p.,	12.0	54.0	1.3	17.0	15.3	—	.8	1000
Round, second cut,	e. p.,	—	69.8	1.3	19.8	8.2	—	.8	750
	a. p.,	19.5	56.2	1.0	15.9	6.6	—	.7	600
Rump,	e. p.,	—	56.7	2.0	16.9	24.2	—	.7	1380
	a. p.,	20.7	45.0	1.6	13.4	19.2	—	.5	1095
Fore shank,	e. p.,	—	67.9	1.4	19.8	11.0	—	.7	865
	a. p.,	36.9	42.9	.9	12.4	6.9	—	.5	545
Hind shank,	e. p.,	—	67.8	1.4	20.3	10.9	—	.7	875
	a. p.,	53.9	31.3	.7	9.3	5.0	—	.3	400
Shoulder and clod,	e. p.,	—	68.3	1.5	19.0	10.7	—	.8	840
	a. p.,	16.4	56.8	1.2	15.9	9.3	—	.7	720
Fore quarter,	e. p.,	—	60.4	1.8	17.4	20.3	—	.7	1220
	a. p.,	18.7	49.1	1.5	14.1	16.6	—	.5	995
Hind quarter,	e. p.,	—	59.8	1.8	17.8	20.5	—	.7	1240
	a. p.,	15.7	50.4	1.6	14.9	17.4	—	.5	1045
Side, lean,	e. p.,	—	67.2	1.3	18.7	12.5	—	.9	910
	a. p.,	19.5	54.1	1.0	15.0	10.1	—	.7	735
Side, medium,	e. p.,	—	59.7	1.8	17.6	20.9	—	.7	1250
	a. p.,	17.4	49.4	1.5	14.4	17.2	—	.5	1030
Side, fat,	e. p.,	—	47.8	2.5	15.7	34.6	—	.5	1805
	a. p.,	13.2	41.5	2.1	13.6	30.0	—	.5	1565
Liver,	e. p.,	—	71.2	1.2	20.4	4.3	1.7	1.2	620
	a. p.,	7.0	66.2	1.2	18.9	4.0	1.6	1.1	580

TABLE 13.—*(Continued.)*

a. p. = as purchased. e. p. = edible portion. See page 112.

KIND OF FOOD MATERIAL.		Refuse.	Water.	Unavailable nutrients.	AVAILABLE NUTRIENTS.				Fuel value per lb.
					Protein.	Fat.	Carbohydrates.	Ash.	
ANIMAL FOODS.		%	%	%	%	%	%	%	Calories.
Beef (fresh).									
Suet (unrendered tallow),	a. p.,	—	13.7	4.3	4.6	77.7	—	.2	3440
Tongue,	e. p.,	—	70.8	1.3	18.3	8.7	—	.8	740
	a. p.,	26.5	51.8	.9	13.7	6.4	—	.6	550
Beef (preserved and cooked).									
Dried and smoked,	e. p.,	—	54.3	3.5	29.1	6.2	—	6.8	850
	a. p.,	4.7	53.7	4.5	25.6	6.6	—	5.5	795
Brisket, corned,	e. p.,	—	50.9	3.2	17.8	23.5	—	4.2	1370
	a. p.,	21.4	40.0	2.5	14.0	18.4	—	3.4	1070
Flank, corned,	e. p.,	—	49.9	2.7	14.2	31.4	—	2.2	1635
	a. p.,	12.1	43.7	2.5	12.5	27.7	—	2.0	1445
Plate, corned,	e. p.,	—	40.1	3.7	13.3	39.8	—	3.5	1980
	a. p.,	14.5	34.3	3.2	11.3	34.0	—	3.0	1690
Rump, corned,	e. p.,	—	58.1	2.2	14.8	22.1	—	2.8	1250
	a. p.,	6.0	54.5	2.3	13.9	20.9	—	2.3	1180
Canned, boiled,	a. p.,	—	51.8	2.2	24.7	21.4	—	1.0	1415
Canned, corned,	a. p.,	—	51.8	2.7	25.5	17.8	—	3.0	1275
Boiled beef (cut not given),	e. p.,	—	38.1	2.7	25.4	33.2	—	.7	1930
Roast, cooked,	e. p.,	—	48.2	2.4	21.6	27.2	—	1.0	1410
Loin steak, cooked,	e. p.,	—	54.8	2.0	22.8	19.4	—	.9	1290
Tripe, pickled,	a. p.,	—	86.5	.6	11.3	1.1	—	.2	275
Veal (fresh).									
Breast,	e. p.,	—	66.0	1.5	18.9	13.3	—	.8	950
	a. p.,	21.3	52.0	1.2	14.9	10.5	—	.6	750
Chuck,	e. p.,	—	73.0	1.1	19.1	6.2	—	.8	650
	a. p.,	18.9	59.5	1.0	15.5	4.9	—	.6	520
Cutlets (round),	e. p.,	—	70.7	1.3	19.7	7.3	—	.8	710
	a. p.,	3.4	68.3	1.2	19.5	7.1	—	.8	695
Flank,	a. p.,	—	68.9	1.3	19.9	9.9	—	.8	825
Leg,	e. p.,	—	70.0	1.3	19.6	8.6	—	.9	760
	a. p.,	14.2	60.1	1.1	15.0	7.5	—	.7	620
Loin,	e. p.,	—	69.0	1.3	19.3	10.3	—	.8	830
	a. p.,	16.5	57.6	1.1	16.1	8.6	—	.7	690
Neck,	e. p.,	—	72.6	1.1	19.7	6.6	—	.8	680
	a. p.,	31.5	49.9	.8	13.5	4.4	—	.5	460
Rib,	e. p.,	—	72.7	1.2	20.1	5.8	—	.8	650
	a. p.,	24.3	46.2	1.3	13.8	13.8	—	.6	870
Shank,	e. p.,	—	74.5	1.0	20.1	4.4	—	.8	590
	a. p.,	62.7	27.8	.4	7.5	1.6	—	.3	220
Fore quarter,	e. p.,	—	71.7	1.2	19.4	7.6	—	.7	715
	a. p.,	24.5	54.2	1.0	14.6	5.7	—	.5	535

TABLE 13.—*(Continued.)*

a. p. = as purchased. e. p. = edible portion. See page 112.

KIND OF FOOD MATERIAL.		Refuse.	Water.	Unavailable nutrients.	AVAILABLE NUTRIENTS.				Fuel value per lb.
					Protein.	Fat.	Carbohydrates.	Ash.	
ANIMAL FOODS.		%	%	%	%	%	%	%	Calories.
Veal (fresh).									
Hind quarter,	e. p.,	—	70.9	1.2	20.1	7.9	—	.8	740
	a. p.,	20.7	56.2	1.0	15.7	6.3	—	.6	585
Side,	e. p.,	—	71.3	1.2	19.6	7.7	—	.8	725
	a. p.,	22.6	55.2	1.0	15.1	6.0	—	.6	560
Liver,	a. p.,	—	73.0	.9	9.7	5.0	—	1.0	410
Lamb (fresh).									
Breast or chuck,	e. p.,	—	56.2	2.0	18.5	22.4	—	.8	1335
	a. p.,	19.1	45.5	1.7	14.9	18.1	—	.6	1075
Leg,	e. p.,	—	63.9	1.7	18.6	15.7	—	.8	1050
	a. p.,	17.4	52.9	1.4	15.4	12.9	—	.7	865
Loin,	e. p.,	—	53.1	2.2	18.1	26.9	—	.8	1520
	a. p.,	14.8	45.3	1.9	15.5	22.9	—	.6	1295
Neck,	e. p.,	—	56.7	1.9	17.2	23.6	—	.8	1360
	a. p.,	17.7	46.7	1.6	14.2	19.4	—	.6	1120
Shoulder,	e. p.,	—	51.8	2.2	17.6	28.2	—	.8	1565
	a. p.,	20.3	41.3	1.8	14.0	22.4	—	.6	1245
Fore quarter,	e. p.,	—	55.1	2.0	17.8	24.5	—	.8	1410
	a. p.,	18.8	44.7	1.7	14.5	19.9	—	.6	1145
Hind quarter,	e. p.,	—	60.9	1.8	19.0	18.1	—	.8	1160
	a. p.,	15.7	51.3	1.5	16.0	15.3	—	.7	980
Side,	e. p.,	—	58.2	2.0	17.1	21.9	—	.8	1285
	a. p.,	19.3	47.0	1.5	13.7	17.8	—	.6	1040
Lamb (cooked).									
Chops, boiled,	e. p.,	—	47.6	2.5	21.0	28.4	—	1.0	1640
	a. p.,	13.5	40.1	2.2	17.8	25.4	—	.9	1445
Leg, roast,	e. p.,	—	67.1	1.4	19.1	12.1	—	.6	905
Mutton (fresh).									
Chuck,	e. p.,	—	50.9	2.4	14.6	31.9	—	.7	1665
	a. p.,	21.3	39.9	1.8	11.5	25.4	—	.5	1325
Flank,	e. p.,	—	46.2	2.6	14.7	36.4	—	.5	1860
	a. p.,	9.9	39.0	2.3	13.4	35.1	—	.5	1780
Leg,	e. p.,	—	62.8	1.7	17.9	17.1	—	.8	1095
	a. p.,	18.4	51.2	1.4	14.6	14.0	—	.6	895
Loin,	e. p.,	—	50.2	2.4	15.5	31.4	—	.6	1660
	a. p.,	16.0	42.0	2.0	13.1	26.9	—	.5	1420
Neck,	e. p.,	—	58.1	2.0	16.4	23.4	—	.7	1335
	a. p.,	27.4	42.1	1.5	11.9	17.0	—	.5	970
Shoulder,	e. p.,	—	61.9	1.7	17.2	18.9	—	.7	1160
	a. p.,	22.5	47.9	1.4	13.3	14.7	—	.5	900
Fore quarter,	e. p.,	—	52.9	2.2	15.1	29.4	—	.7	1570
	a. p.,	21.2	41.6	1.8	11.9	23.3	—	.5	1240
Hind quarter,	e. p.,	—	54.8	2.1	16.2	26.7	—	.6	1475
	a. p.,	17.2	45.4	1.8	13.4	22.0	—	.5	1215
Side,	e. p.,	—	54.2	2.1	15.8	27.5	—	.7	1500
	a. p.,	18.1	45.4	1.8	12.6	21.9	—	.5	1195

TABLE 13.—*(Continued.)*

a. p. = as purchased. e. p. = edible portion. See page 112.

KIND OF FOOD MATERIAL.	Refuse.	Water.	Unavailable nutrients.	AVAILABLE NUTRIENTS. Protein.	Fat.	Carbohydrates.	Ash.	Fuel value per lb.
ANIMAL FOODS.	%	%	%	%	%	%	%	Calories.
Mutton (cooked and canned).								
Leg, roast, - - e. p.,	—	50.9	2.1	24.3	21.5	—	.9	1410
Corned, canned, - a. p.,	—	45.8	3.0	27.9	21.7	—	3.2	1490
Tongue, canned, - a. p.,	—	47.6	3.1	23.7	22.8	—	3.6	1455
Pork (fresh).								
Chuck, ribs and shoulder, - - e. p.,	—	51.1	2.3	16.8	29.5	—	.7	1605
a. p.,	18.1	41.8	1.9	13.7	24.2	—	.6	1315
Flank, - - - e. p.,	—	59.0	1.9	17.9	21.1	—	.8	1265
a. p.,	18.0	48.5	1.6	14.6	17.7	—	.5	1055
Loin, chops, - - e. p.,	—	52.0	2.2	16.1	28.6	—	.8	1555
a. p.,	19.7	41.8	1.8	13.0	23.0	—	.6	1250
Ham, - - - e. p.,	—	53.9	2.1	14.8	27.5	—	.6	1480
a. p.,	10.7	48.0	1.9	13.1	24.6	—	.6	1320
Shoulder, - - e. p.,	—	51.2	2.3	12.9	32.5	—	.6	1660
a. p.,	12.4	44.9	2.1	11.6	28.3	—	.5	1450
Side, - - - e. p.,	—	34.4	3.2	8.8	52.5	—	.4	2440
a. p.,	11.5	30.4	2.8	7.8	46.5	—	.4	2160
Pork (pickled, salted and smoked.								
Bacon, - - - e. p.,	—	18.8	4.8	9.6	64.0	—	3.3	2950
a. p.,	7.7	17.4	4.4	8.8	59.1	—	3.1	2720
Ham, - - - e. p.,	—	40.3	3.6	15.8	36.9	—	3.6	1905
a. p.,	13.6	34.8	3.1	13.8	31.7	—	3.2	1640
Shoulder, - - e. p.,	—	45.0	3.8	15.4	30.9	—	5.0	1640
a. p.,	18.2	36.8	3.1	12.6	25.3	—	4.1	1340
Salt, lean ends, - e. p.,	—	19.9	5.1	8.1	63.7	—	4.3	2905
a. p.,	11.2	17.6	4.5	7.2	56,6	—	3.8	2580
Salt, fat, - - a. p.,	—	7.9	5.4	1.8	81.9	—	2.9	3565
Pigs' feet, pickled, - e. p.,	—	68.2	1.4	15.8	14.1	—	.7	920
a. p.,	35.5	44.6	.9	9.9	8.8	—	.5	575
Pork (cooked).								
Ribs, cooked, - - a. p.,	—	33.6	3.1	24.1	35.7	—	1.7	2020
Steak, cooked, - a. p.,	—	33.2	3.3	19.3	43.1	—	1.1	2245
Sausage.								
Bologna, - - e. p.,	—	60.0	2.4	18.1	16.7	0.3	2.8	1085
a. p.,	3.3	55.2	2.4	17.7	18.7	—	2.9	1160
Frankfort, - - a. p.,	—	57.2	2.3	19.0	17.7	1.1	2.6	1160
Pork, - - - a. p.,	—	39.8	3.1	12.6	42.0	1.1	1.7	2080

TABLE 13.—*(Continued).*

a. p. = as purchased. e. p. = edible portion. See page 112.

KIND OF FOOD MATERIAL.	Refuse.	Water.	Unavailable nutrients.	AVAILABLE NUTRIENTS.				Fuel value per lb.
				Protein.	Fat.	Carbohydrates.	Ash.	
ANIMAL FOODS.	%	%	%	%	%	%	%	Calories.
Poultry and game (fresh).								
Chicken, broilers, e. p.,	—	74.8	1.0	20.9	2.4	—	.8	520
Chicken, broilers, a. p.,	41.6	43.7	.7	12.4	1.3	—	.5	305
Fowl, e. p.,	—	63.7	1.6	18.7	15.5	—	.8	1040
Fowl, a. p.,	25.9	47.1	1.2	13.3	11.7	—	.5	770
Goose, e. p.,	—	46.7	2.5	15.8	34.4	—	.6	1800
Goose, a. p.,	17.6	38.5	2.1	13.0	28.3	—	.5	1480
Turkey, e. p.,	—	55.5	1.9	20.5	21.8	—	.8	1350
Turkey, a. p.,	22.7	42.4	1.6	15.6	17.5	—	.6	1065
Poultry and game (cooked and canned).								
Capon, e. p.,	—	59.9	1.7	26.2	10.9	—	1.0	995
Capon, a. p.,	10.4	53.6	1.5	23.5	9.8	—	.9	890
Turkey, roast, a. p.,	—	67.5	1.3	17.1	10.9	2.4	.8	855
Plover, roast, canned, a. p.,	—	57.7	1.7	21.7	9.7	7.6	1.6	985
Quail, canned, a. p.,	—	66.9	1.6	21.1	7.6	1.7	1.1	780
Fish (fresh).								
Bass, black, whole, e. p.,	—	76.7	1.0	20.0	1.6	—	.9	470
Bass, black, whole, a. p.,	54.8	34.6	.4	9.0	.8	—	.4	215
Blue fish, e. p.,	—	78.5	1.0	18.8	1.1	—	1.0	420
Blue fish, a. p.,	48.6	40.3	.5	9.7	.6	—	.5	220
Cod fish, dressed, a. p.,	29.9	58.5	.5	10.8	.2	—	.6	225
Cod steaks, e. p.,	—	79.7	.9	18.1	.5	—	.9	385
Cod steaks, a. p.,	9.2	72.4	.7	16.5	.5	—	.8	350
Flounder, whole, e. p.,	—	84.2	.7	13.8	.6	—	1.0	300
Flounder, whole, a. p.,	61.5	32.6	.3	5.2	.3	—	.4	115
Haddock, e. p.,	—	81.7	.8	16.7	.3	—	.9	345
Haddock, a. p.,	51.0	40.0	.4	8.1	.2	—	.5	170
Halibut steak, e. p.,	—	75.4	1.1	18.0	4.9	—	.8	570
Halibut steak, a. p.,	17.7	61.9	.9	14.8	4.2	—	.7	475
Lake trout, e. p.,	—	70.8	1.3	17.3	9.8	—	.9	765
Lake trout, a. p.,	48.5	36.6	.7	8.8	4.8	—	.5	380
Mackerel, e. p.,	—	73.4	1.3	18.1	6.7	—	.9	650
Mackerel, a. p.,	44.7	40.4	.7	9.9	4.0	—	.5	370
Weakfish, e. p.,	—	79.0	.9	17.3	2.3	—	.9	445
Weakfish, a. p.,	51.9	38.0	.5	8.3	1.0	—	.5	210
Whitefish, whole, e. p.,	—	69.8	1.4	22.2	6.2	—	1.2	710
Whitefish, whole, a. p.,	53.5	32.5	.6	10.3	2.9	—	.5	330
Shell fish (fresh).								
Long clams, in shell, e. p.,	—	85.8	1.0	8.3	.9	2.0	2.0	240
Long clams, in shell, a. p.,	41.9	49.9	.5	4.9	.6	1.1	1.1	145
R'nd clams, in shell, e. p.,	—	86.2	.9	6.3	.4	4.2	2.0	215
R'nd clams, in shell, a. p.,	67.5	28.0	.3	2.0	.1	1.4	.7	70

TABLE 13.—*(Continued.)*

a. p. = as purchased. e. p. = edible portion. See page 112.

KIND OF FOOD MATERIAL.		Refuse.	Water.	Unavailable nutrients.	AVAILABLE NUTRIENTS.				
					Protein.	Fat.	Carbohydrates.	Ash.	Fuel value per lb.
ANIMAL FOODS.		%	%	%	%	%	%	%	Calories.
Shell fish (fresh).									
Oysters, in shell,	e. p.,	—	86.9	.8	6.0	1.1	3.7	1.5	235
	a. p.,	81.4	16.1	.1	1.2	.2	.7	.3	45
Oysters, solids,	a. p.,	—	88.3	.6	5.8	1.2	3.3	.8	225
Clams, round, solids,	a. p.,	—	80.8	1.0	10.3	1.0	5.2	1.7	340
Crabs, hard shells,	e. p.,	—	77.1	1.4	16.1	1.9	1.2	2.3	425
	a. p.,	52.4	36.7	.6	7.7	.9	.6	1.1	200
Lobster,	e. p.,	—	79.2	1.1	15.9	1.7	.4	1.7	400
	a. p.,	61.7	30.7	.4	5.7	.7	.2	.6	145
Fish (preserved and canned).									
Cod, salt,	e. p.,	—	53.5	6.8	20.9	.3	—	18.5	430
	a. p.,	24.9	40.2	5.1	15.5	.4	—	13.9	325
Cod, salt, boneless,	e. p.,	—	55.0	5.5	24.9	.3	—	14.3	510
	a. p.,	1.6	54.8	4.6	27.7	.3	—	11.0	565
Halibut, smoked,	e. p.,	—	49.4	5.0	20.1	14.3	—	11.3	1015
	a. p.,	7.0	46.0	4.8	18.7	13.3	—	10.4	945
Herring, smoked,	e. p.,	—	34.6	5.2	35.8	15.0	—	9.9	1360
	a. p.,	44.4	19.2	2.8	19.9	8.4	—	5.6	760
Mackerel, salt, dressed,	e. p.,	—	43.4	5.0	16.8	25.1	—	9.7	1415
	a. p.,	19.7	34.8	4.1	13.5	20.1	—	7.8	1135
Salmon, canned,	e. p.,	—	63.5	1.9	21.1	11.5	—	2.0	915
	a. p.,	14.2	56.8	1.5	18.9	7.1	—	1.5	685
Sardines, canned,	e. p.,	—	52.3	3.1	22.3	18.7	—	4.2	1250
	a. p.,	5.0	53.6	2.6	23.0	11.5	—	4.0	955
Lobster, canned,	a. p.,	—	77.8	1.3	17.6	1.0	.4	1.9	400
Clams, canned,	a. p.,	—	82.9	1.0	10.2	.8	3.0	2.1	290
Oysters, canned,	a. p.,	—	83.4	.8	8.5	2.3	3.9	1.1	340
Eggs.									
Eggs, uncooked,	e. p.,	—	73.7	1.1	13.0	10.0	—	.8	695
	a. p.,	11.2	65.5	1.1	11.5	8.8	—	.7	615
Eggs, boiled,	e. p.,	—	73.2	1.2	12.8	11.4	—	.6	755
	a. p.,	11.2	65.0	1.1	11.3	10.2	—	.5	670
Dairy products, etc.									
Whole milk,	a. p.,	—	87.0	.5	3.2	3.8	5.0	.5	310
Skim milk,	a. p.,	—	90.5	.3	3.3	.3	5.1	.5	170
Condensed milk, sweetened,	a. p.,	—	26.9	1.2	8.5	7.9	54.1	1.4	1460
Cream,	a. p.,	—	74.0	1.1	2.4	17.6	4.5	.4	860
Cheese,	a. p.,	—	34.2	3.4	25.1	32.0	2.4	2.9	1885
Butter,	a. p.,	—	11.0	4.9	1.0	80.8	—	2.3	3410
Oleomargarine, etc.,	a. p.,	—	9.5	5.7	1.2	78.9	—	4.7	3335
Lard, cottolene, etc.,	a. p.,	—	—	5.0	—	95.0	—	—	3985

TABLE 13.—*(Continued.)*

a. p. = as purchased. e. p. = edible portion. See page 112.

KIND OF FOOD MATERIAL.	Refuse.	Water.	Unavailable nutrients.	AVAILABLE NUTRIENTS.				Fuel value per lb.
				Protein.	Fat.	Carbohydrates.	Ash.	
ANIMAL FOOD.	%	%	%	%	%	%	%	Calories.
Miscellaneous.								
Gelatin, - - - a. p.,	—	13.6	3.2	88.7	.1	—	1.6	2125
Calf's-foot jelly, - a. p.,	—	77.6	.3	4.2	—	17.4	.5	410
VEGETABLE FOODS.								
Cereals, etc.								
Barley, pearled, - -	—	11.5	4.0	6.6	1.0	76.1	.8	1630
Buckwheat flour, - -	—	13.6	3.5	5.2	1.1	75.9	.7	1600
Buckwheat, self-raising, -	—	11.6	4.9	6.7	1.1	71.5	4.2	1545
Corn (maize) flour, - -	—	12.6	3.6	5.8	1.2	76.3	.5	1625
Corn (maize) meal, - -	—	12.5	4.0	7.5	1.7	73.5	.8	1625
Corn (maize) preparations:								
Cerealine, - - -	—	10.3	4.2	7.8	1.0	76.3	.4	1655
Hominy, - - -	—	11.8	3.8	6.8	.5	76.9	.2	1625
Hominy, cooked, -	—	79.3	.9	1.8	.2	17.4	.4	375
Oatmeal and rolled oats,	—	7.8	5.6	13.4	6.6	65.2	1.4	1795
Oatmeal, boiled, - -	—	84.5	.9	2.3	.5	11.3	.5	285
Rice, - - - -	—	12.3	3.7	6.5	.3	76.9	.3	1610
Rice, boiled, - - -	—	72.5	1.1	2.3	.1	23.8	.2	505
Rye flour, - - -	—	12.9	3.6	5.3	.8	76.9	.5	1610
Entire wheat flour, - -	—	11.4	4.5	10.7	1.7	70.9	.8	1645
Gluten flour, - - -	—	12.0	4.6	11.0	1.6	70.1	.7	1630
Graham flour, - - -	—	11.3	4.7	10.3	2.0	70.4	1.3	1640
Wheat flour, patent process:								
Low grade, - - -	—	12.0	4.5	10.9	1.7	70.2	.7	1635
Bakers' grade, - -	—	11.9	4.2	10.3	1.4	71.7	.5	1640
Family and straight grade,	—	12.8	4.0	8.3	1.0	73.5	.4	1615
High grade, - -	—	12.4	4.0	8.7	.9	73.6	.4	1620
Wheat preparations:								
Breakfast foods, - -	—	9.6	4.5	9.3	1.6	74.0	1.0	1670
Macaroni, - - -	—	10.3	4.5	10.4	.8	73.0	1.0	1640
Macaroni, cooked, -	—	78.4	1.3	2.3	1.4	15.6	1.0	405
Spaghetti, - - -	—	10.6	4.0	9.4	.4	75.1	.5	1640
Noodles, - - -	—	10.7	4.2	9.1	.9	74.3	.8	1640
Bread:								
Brown, - - -	—	43.6	2.8	4.2	1.6	46.2	1.6	1035
Corn (johnnycake), -	—	38.9	3.5	6.5	4.2	45.2	1.7	1170
Rye, - - - -	—	35.7	3.4	7.3	.5	52.0	1.1	1160
Graham, - - -	—	35.7	3.4	6.9	1.6	51.3	1.1	1185
Whole wheat, - -	—	38.4	3.2	7.5	.8	49.1	1.0	1125
White wheat, - -	—	35.3	3.3	7.1	1.2	52.3	.8	1195
Biscuit, soda,* - -	—	22.9	4.7	7.2	12.3	51.8	1.1	1655
Rolls, - - - -	—	29.2	3.6	6.9	3.7	55.8	.8	1360
Toasted bread, - -	—	24.0	4.1	8.9	1.4	60.3	1.3	1390

* Made from wheat flour, raised with baking soda.

TABLE 13.—*(Continued.)*

a. p. = as purchased. e. p. = edible portion. See page 112.

KIND OF FOOD MATERIAL.	Refuse.	Water.	Unavailable nutrients.	AVAILABLE NUTRIENTS.				Fuel value per lb.
				Protein.	Fat.	Carbohydrates.	Ash.	
VEGETABLE FOODS.	%	%	%	%	%	%	%	Calories.
Cereals, etc.								
Crackers:								
Boston (split),	—	7.5	5.0	8.5	7.7	69.9	1.4	1830
Milk cream,	—	6.8	5.0	7.5	10.9	68.5	1.3	1920
Graham,	—	5.4	4.8	7.7	8.5	72.5	1.1	1900
Oyster,	—	4.8	5.4	8.8	9.5	69.3	2.2	1905
Soda,	—	5.9	4.9	7.6	8.2	71.8	1.6	1870
Water,	—	6.8	5.0	8.3	7.9	70.6	1.4	1850
Cakes, cookies, etc.:								
Bakers' cake,	—	31.4	3.3	4.8	4.1	55.8	.6	1335
Coffee cake,	—	21.3	3.8	5.5	6.8	61.9	.7	1580
Gingerbread,	—	18.8	4.3	4.5	8.1	62.1	2.2	1620
Sponge cake,	—	15.3	4.4	4.8	9.6	64.5	1.4	1735
Drop cake,	—	16.6	4.5	5.9	13.2	59.2	.6	1805
Molasses cookies,	—	6.2	4.7	5.6	7.8	74.0	1.7	1855
Sugar cookies,	—	8.3	4.5	5.4	9.2	71.6	1.0	1865
Ginger snaps,	—	6.3	4.7	5.0	7.7	74.3	2.0	1845
Wafers,	—	6.6	4.8	6.7	7.7	73.0	1.2	1855
Doughnuts,	—	18.3	4.8	5.2	18.9	52.1	.7	1895
Pie, pudding, etc.:								
Pie, apple,	—	42.5	3.1	2.4	8.8	41.8	1.4	1215
Pie, custard,	—	62.4	2.2	3.2	5.7	25.7	.8	795
Pie, squash,	—	64.2	2.4	3.4	7.6	21.4	1.0	800
Pudding, Indian meal,	—	60.7	2.5	4.5	4.3	26.9	1.1	785
Pudding, rice custard,	—	59.4	2.1	3.2	4.1	30.7	.5	825
Pudding, tapioca,	—	64.5	1.0	2.8	2.9	28.2	.6	715
Sugars, starches, etc.								
Sugar, granulated,	—	—	—	—	—	100.0	—	1790
Sugar, pulverized,	—	—	—	—	—	100.0	—	1790
Sugar, brown,	—	—	—	—	—	95.0	—	1700
Sugar, maple,	—	—	—	—	—	82.8	—	1485
Molasses,	—	—	—	—	—	70.0	—	1255
Maple syrup,	—	—	—	—	—	71.0	—	1270
Cornstarch,	—	—	—	—	—	90.0	—	1715
Tapioca,	—	11.4	.1	.3	.1	88.0	.1	1685
Sago,	—	12.2	1.4	7.7	.4	78.1	.2	1665
Vegetables.								
Asparagus, fresh,	—	94.0	.7	1.3	.2	3.3	.5	95
Asparagus, cooked,	—	91.6	1.0	1.7	3.0	2.1	.6	195
Beans, Lima, green, e. p.,	—	68.5	2.7	5.3	.6	21.6	1.3	525
Beans, Lima, green, a. p.,	55.0	30.8	1.2	2.4	.3	9.7	.6	240

TABLE 13.—*(Continued.)*

a. p. = as purchased. e. p. = edible portion. See page 112.

KIND OF FOOD MATERIAL.	Refuse.	Water.	Unavailable nutrients.	AVAILABLE NUTRIENTS.				Fuel value per lb.
				Protein.	Fat.	Carbohydrates.	Ash.	
VEGETABLE FOODS. *Vegetables.*	%	%	%	%	%	%	%	Calories.
Beans, Lima, dried, -	—	10.4	6.7	12.8	1.4	65.6	3.1	1565
Beans, string, fresh, e. p.,	—	89.2	1.0	1.7	.3	7.2	.6	180
Beans, string, fresh, a. p.,	7.0	83.0	.9	1.6	.3	6.7	.5	165
Beans, string, cooked,* -	—	95.3	.5	.6	1.0	1.9	.7	90
Beans, white, dried, -	—	12.6	7.5	15.8	1.6	59.9	2.6	1530
Beans, baked, - - -	—	68.9	2.8	4.8	2.3	19.6	1.6	565
Beets, fresh, - - e. p.,	—	87.5	1.0	1.2	.1	9.4	.8	205
Beets, fresh, - - a. p.,	20.0	70.0	.8	1.0	.1	7.4	.7	160
Beets, cooked,* - -	—	88.6	1.2	1.7	.1	7.2	1.2	170
Beet "greens," cooked,*	—	89.5	1.2	1.7	3.1	3.2	1.3	220
Cabbage, - - e. p.,	—	91.5	.7	1.2	.3	5.5	.8	140
Cabbage, - - a. p.,	15.0	77.7	.6	1.1	.2	4.7	.7	115
Carrots, fresh, - e. p.,	—	88.2	1.0	.7	.4	8.9	.8	200
Carrots, fresh, - a. p.,	20.0	70.6	.6	.8	.2	7.1	.7	155
Carrots, cooked,* - -	—	3.5	6.9	5.8	3.2	76.9	3.7	1700
Cauliflower, - - -	—	92.3	.7	1.3	.5	4.7	.5	135
Celery, - - - e. p.,	—	94.5	.6	.8	.1	3.2	.8	80
Celery, - - - a. p.,	20.0	75.6	.4	.7	.1	2.6	.6	65
Sweet corn, green, - e. p.,	—	75.4	1.8	2.3	1.0	19.0	.5	445
Sweet corn, green, - a. p.,	61.0	29.4	.7	.9	.4	7.4	.2	175
Cucumbers, - - e. p.,	—	95.4	.4	.6	.2	3.0	.4	75
Cucumbers, - - a. p.,	15.0	81.1	.3	.5	.2	2.6	.3	65
Egg plant, - - -	—	92.9	.6	.9	.3	4.9	.4	120
Lettuce, - - - e. p.,	—	94.7	.5	.9	.3	2.9	.7	85
Lettuce, - - - a. p.,	15.0	80.5	.5	.7	.2	2.5	.6	70
Onions, fresh, - e. p.,	—	87.6	.8	1.2	.3	9.6	.5	215
Onions, fresh, - a. p.,	10.0	78.9	.7	1.1	.3	8.6	.4	195
Onions, cooked,* - -	—	91.2	.8	.9	1.6	4.8	.7	175
Parsnips, - - e. p.,	—	83.0	1.2	1.2	.5	13.0	1.1	290
Parsnips, - - a. p.,	20.0	66.4	1.0	1.0	.4	10.4	.8	230
Peas, dried, - - -	—	9.5	7.6	17.3	.9	62.5	2.2	1580
Peas, green, - - e. p.,	—	74.6	2.2	5.2	.5	16.7	.8	430
Peas, green, - - a. p.,	45.0	40.8	1.2	2.7	.2	9.6	.5	235
Peas, green, cooked,* -	—	73.8	2.5	5.1	3.1	14.4	1.1	490
Potatoes, - - e. p.,	—	78.3	1.4	1.7	.1	17.7	.8	370
Potatoes, - - a. p.,	20.0	62.6	1.2	1.3	.1	14.2	.6	295
Potatoes, cooked, boiled,	—	75.5	1.7	1.9	.1	20.0	.8	415
Potatoes, mashed and creamed, - -	—	75.1	2.0	2.0	2.7	17.1	1.1	475
Pumpkins, - - e. p.,	—	93.1	.6	.7	.1	5.0	.5	110
Pumpkins, - - a. p.,	50.0	46.5	.3	.3	.1	2.6	.2	60
Radishes, - - e. p.,	—	91.8	.7	1.0	.1	5.6	.8	130
Radishes, - - a. p.,	30.0	64.3	.5	.7	.1	3.9	.5	90
Rhubarb, - - e. p.,	—	94.4	.6	.4	.6	3.5	.5	100
Rhubarb, - - a. p.,	40.0	56.6	.3	.3	.4	2.1	.3	60
Squash, - - - e. p.,	—	88.3	.9	1.1	.5	8.6	.6	205
Squash, - - - a. p.,	50.0	44.2	.4	.5	.2	4.4	.3	100

* With butter, etc., added.

TABLE 13.—*(Continued.)*

a. p. = as purchased. e. p. = edible portion. See page 112.

KIND OF FOOD MATERIAL.	Refuse.	Water.	Unavailable nutrients.	AVAILABLE NUTRIENTS.				Fuel value per lb.
				Protein.	Fat.	Carbohydrates.	Ash.	
VEGETABLE FOODS.	%	%	%	%	%	%	%	Calories.
Vegetables.								
Spinach, fresh,	—	92.3	1.0	1.6	.3	3.2	1.6	100
Spinach, cooked,*	—	89.8	1.1	1.6	3.7	2.7	1.1	235
Sweet potatoes, fresh, e. p.,	—	69.0	2.1	1.3	.6	26.2	.8	545
Sweet potatoes, fresh, a. p.,	20.0	55.2	1.6	1.1	.5	20.9	.7	440
Sweet potatoes, cooked,*	—	51.9	3.0	2.2	1.9	40.3	.7	885
Tomatoes,	—	94.3	.4	.7	.4	3.8	.4	100
Turnips, e. p.,	—	89.6	.8	1.0	.2	7.8	.6	175
Turnips, a. p.,	30.0	62.7	.5	.7	.1	5.5	.5	120
Vegetables (canned).								
Asparagus,	—	94.4	.6	1.2	.1	2.8	.9	80
Beans, baked,	—	68.9	2.7	4.8	2.3	19.7	1.6	555
Beans, string,	—	93.7	.7	.8	.1	3.7	1.0	90
Beans, Lima,	—	79.5	1.7	3.0	.3	14.3	1.2	335
Sweet corn,	—	76.1	1.7	2.1	1.1	18.3	.7	430
Peas, green,	—	85.3	1.4	2.7	.2	9.6	.8	235
Succotash,	—	75.9	1.8	2.7	.9	18.0	.7	425
Tomatoes,	—	94.0	.5	.9	.2	3.9	.5	100
Fruits, etc. (fresh).								
Apples, e. p.,	—	84.6	1.6	.3	.5	12.8	.2	260
Apples, a. p.,	25.0	63.3	1.2	.3	.3	9.7	.2	195
Apricots, e. p.,	—	85.0	1.5	.9	—	12.2	.4	240
Apricots, a. p.,	6.0	79.9	1.5	.8	—	11.4	.4	220
Bananas, e. p.,	—	75.3	2.7	1.0	.5	19.9	.6	400
Bananas, a. p.,	35.0	48.9	1.6	.6	.4	13.0	.5	265
Blackberries,	—	86.3	1.5	1.0	.9	9.9	.4	235
Cherries, e. p.,	—	80.9	2.0	.8	.7	15.1	.5	320
Cherries, a. p.,	5.0	76.8	1.9	.7	.7	14.4	.5	305
Cranberries,	—	88.9	1.2	.3	.5	8.9	.2	190
Currants,	—	85.0	1.7	1.2	—	11.6	.5	230
Figs,	—	79.1	2.2	1.2	—	17.0	.5	330
Grapes, e. p,,	—	77.4	2.4	1.1	1.4	17.3	.4	390
Grapes, a. p.,	25.0	58.0	1.7	.8	1.1	13.1	.3	300
Huckleberries,	—	81.9	2.0	.5	.5	14.9	.2	300
Lemons, e. p.,	—	89.3	1.2	.8	.6	7.7	.4	180
Lemons, a. p.,	30.0	62.5	.9	.5	.4	5.4	.3	125
Muskmelons, e. p.,	—	89.5	1.1	.5	—	8.4	.5	160
Muskmelons, a. p.,	50.0	44.8	.6	.3	—	4.1	.2	80
Oranges, e. p.,	—	86.9	1.4	.6	.2	10.5	.4	210
Oranges, a. p.,	27.0	63.4	1.1	.5	.1	7.6	.3	150
Pears, e. p.,	—	84.4	1.7	.5	.4	12.7	.3	255
Pears, a. p.,	10.0	76.0	1.5	.4	.4	11.4	.3	230
Plums, e. p.,	—	78.4	2.2	.8	—	18.2	.4	345
Plums, a. p.,	5.0	74.5	2.1	.7	—	17.3	.4	325

* With butter, etc., added.

TABLE 13.—*(Continued.)*

a. p. = as purchased. e. p. = edible portion. See page 112.

KIND OF FOOD MATERIAL.	Refuse.	Water.	Unavailable nutrients.	AVAILABLE NUTRIENTS.				Fuel value per lb.
				Protein.	Fat.	Carbohydrates.	Ash.	
VEGETABLE FOODS.	%	%	%	%	%	%	%	Calories.
Fruits, etc. (fresh).								
Prunes, e. p.,	—	79.6	2.1	.7	—	17.1	.5	325
Prunes, a. p.,	6.0	75.4	2.0	.5	—	15.7	.4	295
Raspberries, black,	—	84.1	1.7	1.4	.9	11.4	.5	270
Strawberries, e. p.,	—	90.4	1.0	.8	.5	6.8	.5	160
Strawberries, a. p.,	5.0	85.9	1.0	.7	.5	6.4	.5	150
Watermelons, e. p.,	—	92.4	.9	.3	.2	6.0	.2	125
Watermelons, a. p.,	60.0	36.9	.3	.2	.1	2.4	.1	50
Fruits, etc. (dried).								
Apples,	—	28.1	7.5	1.3	2.0	59.6	1.5	1190
Apricots,	—	29.4	7.7	3.7	.9	56.5	1.8	1130
Citron,	—	19.0	8.3	.4	1.3	70.3	.7	1340
Currants,	—	17.2	8.6	1.9	1.5	67.0	3.8	1315
Dates, e. p.,	—	15.4	8.8	1.6	2.5	70.7	1.0	1415
Dates, a. p.,	10.0	13.8	8.0	1.5	2.2	63.6	.9	1275
Figs,	—	18.8	8.7	3.4	.3	67.0	1.8	1290
Raisins, e. p.,	—	14.6	9.1	2.0	3.0	68.7	2.6	1410
Raisins, a. p.,	10.0	13.1	8.3	1.8	2.7	61.8	2.3	1270
Prunes, e. p.,	—	22.3	8.3	1.6	—	66.1	1.7	1230
Prunes, a. p.,	15.0	19.0	7.0	1.4	—	56.1	1.5	1045
Fruits, etc. (canned).								
Apricots,	—	81.4	1.9	.7	—	15.7	.3	295
Blackberries,	—	40.0	6.1	.6	1.9	50.9	.5	1015
Blueberries,	—	85.6	1.6	.5	.5	11.5	.3	240
Cherries,	—	77.2	2.3	.9	.1	19.1	.4	365
Crab-apples,	—	42.4	5.7	.3	2.2	49.0	.4	985
Peaches,	—	88.1	1.3	.5	.1	9.8	.2	190
Pears,	—	81.1	1.9	.3	.3	16.2	.2	310
Strawberries (stewed),	—	74.8	2.6	.5	—	21.7	.4	400
Nuts.								
Almonds, e. p.,	—	4.8	10.9	17.8	49.4	15.6	1.5	2685
Almonds, a. p.,	45.0	2.7	5.9	9.8	27.2	8.6	.8	1480
Butternuts, e. p.,	—	4.4	11.4	23.7	55.1	3.2	2.2	2805
Butternuts, a. p.,	86.0	.6	1.6	3.3	7.7	.5	.3	385
Chestnuts (fresh), e. p.,	—	45.0	5.9	5.3	4.9	37.9	1.0	990
Chestnuts (fresh), a. p.,	16.0	37.8	5.0	4.4	4.1	31.9	.8	830
Cocoanuts, e. p.,	—	14.1	9.2	4.8	45.5	25.1	1.3	2460
Cocoanuts, a. p.,	49.0	7.2	4.6	2.5	23.1	12.9	.7	1260
Filberts, e. p.,	—	3.7	10.7	13.3	58.8	11.7	1.8	2930
Filberts, a. p.,	52.0	1.8	5.1	6.4	28.3	5.6	.8	1405
Hickory nuts, e. p.,	—	3.7	10.6	13.1	60.7	10.3	1.6	2980
Hickory nuts, a. p..	62.0	1.4	4.0	4.9	23.2	3.9	.6	1130
Peanuts, e. p.,	—	9.2	10.7	21.9	34.7	22.0	1.5	2255
Peanuts, a. p.,	25.0	6.9	8.1	16.6	26.2	16.6	1.1	1525

STUDIES OF DIETARIES OF COLLEGE STUDENTS AND OF MEMBERS OF FAMILIES OF PROFESSIONAL MEN.

REPORTED BY W. O. ATWATER AND R. D. MILNER.

As an important part of a more general inquiry into the subject of food economy, the Station has made studies of dietaries in order to obtain information concerning the dietary customs and actual food consumption of people in different localities and conditions of living. Such information, taken in connection with the composition, digestibility, and actual nutritive value of food materials, as discussed to some extent on preceding pages of this Report,* and the fundamental laws of nutrition, as revealed by experimental inquiries such as those made by the Station with men, and to be made, as it is hoped, with animals, in the Respiration Calorimeter, will gradually make it possible to point out the more common dietary errors, and to suggest methods of improvement to the advantage of both health and purse.

Although the number of dietary studies already made is quite large the results emphasize the importance of continued research along these lines. Fortunately, the interest of public and private institutions in the subject is increasing, and inquiries are now being made in different parts of the country by experiment stations, colleges, and various organizations, as well as by private individuals, both in coöperation with the United States Department of Agriculture and independently, so that the much needed information is accumulating more rapidly than would otherwise be possible.

In previous Reports of the Station accounts of forty-seven dietary studies have been given, comprising ten of farmers' families, nine of mechanics' families, nine of professional men's families, five of students' boarding clubs, and fourteen miscellaneous studies. In the present Report details are given of nine additional studies, including two made in the Connecticut Hospital for the Insane, five of dietaries of individual college students, one of an individual professional man, and one of a

* See pages 69-123.

professional man's family. The main results of these inquiries, including all the data used in the computations, are given in the following statements and tables. The dietary studies in the State Hospital for the Insane are, however, treated briefly by themselves in the succeeding article.

Methods.—The methods of dietary study followed by the Station have been fully described in former Reports.* The general plan includes (1) determinations of the amounts and costs of all the different food materials on hand at the beginning of, purchased during, and remaining on hand at the end of the investigations; (2) when practicable, the collection and analysis of kitchen and table waste; (3) a record of the weight, age, sex, and occupation of the different members of the group under observation, and the number of meals taken by each. From these data, and those for the composition of food materials, as determined by analyses of samples of the materials actually used or as assumed from averages of analyses of similar materials, the total amounts of protein, fats, and carbohydrates in the dietary and the amounts consumed per man per day are computed.

In carrying out the studies here reported the usual methods were followed as far as possible. In the two dietary studies carried out in the Hospital for the Insane (Nos. 253 and 254), the methods were necessarily somewhat modified. For instance, the various kitchens of the Hospital are served each day with raw materials from the general supply. In making a study in two of the buildings, therefore, it was not practicable to take an inventory of the materials on hand at the beginning and end of the study. The usual data concerning the kinds and amounts of foods consumed were obtained by keeping record of the weight of all the food materials used in the kitchen in the preparation of each meal. Weights were also taken of all materials sent from the kitchen to the dining room, and returned from the dining room to the kitchen. Considerable of the data thus obtained were, therefore, for the cooked foods actually eaten. In estimating the amounts of nutrients contained in these materials the composition was calculated from the total weight of the cooked product and the weights and composition of the raw ingredients used in preparing them.

In the studies of three individual college students (Nos. 318, 319, and 320), there were also some modifications of the usual methods. The data concerning the kinds and amounts of food actually consumed were obtained by the students, each of whom weighed, at the table, all of the food that was served to him for each meal, and recorded the weight together with such information as he could give concerning the character of the food, the method of preparing it, etc. In these studies the large majority of the statistics are, therefore, for cooked food materials as prepared for the table. It was not possible to make analyses of samples of the foods eaten nor to get data by which to calculate the composition of the cooked foods from the weights and composition of their ingredients. The percentages of nutrients in the foods were assumed to be the same as in similar cooked food materials, the composition of which had been already determined or computed. But it is obvious that the composition of such materials will vary widely, according to the recipes used in their preparation. The results of these studies, therefore, may be considered less reliable than the

* See Reports of this Station for 1891–96.

results of studies made according to the usual method; but they serve the purpose for which they were made and give a fair indication of the food consumption of the subjects.

Composition of food materials.—No analyses of food materials were made in connection with these studies. Most of the materials used were staple articles of diet, and their composition was assumed to be the same as the average composition of similar materials given in Bulletin 28, revised, of the Office of Experiment Stations of the United States Department of Agriculture.* In some of the studies, however, it was necessary to take the weights of the cooked foods as they were used. In several of these cases the percentage composition was calculated from the weights of the cooked foods and the weights and composition of the raw ingredients used in preparing them. The percentages of nutrients assumed for the cooked foods, according to such computation, are given in Table 14. Where it was impossible to obtain the weight of the raw ingredients the composition of the cooked food was assumed from analyses of similar foods. The reference numbers opposite the names of the various materials in the first table of each dietary study refer to the corresponding numbers in Table 14. In the case of the materials for which no reference number is given the percentage composition was taken from the Bulletin referred to above.

Details of the individual studies.—The introductory statements for each dietary study give the statistics concerning the number of persons in the study, the number of meals eaten by each, etc. The first table for each study gives the amounts, and the costs where known, of the different food materials used during the period of the study. The second table in each case gives the quantities of nutrients per man or per person per day furnished by the different groups of food materials, and the percentages which the different kinds of food and the nutrients contained in them make of the total food and total nutrients of the dietary. It shows also the fuel values of the nutrients and the amounts of nutrients and energy wasted.

Waste.—The words "refuse" and "waste" are ordinarily used somewhat indiscriminately. In general, "refuse" in animal food represents inedible material, although bone, tendon, etc., which are classed as refuse may be utilized for soup. The refuse of vegetable foods, such as parings, seeds, etc., represent not only inedible material, but also more or less edible material, according to the care used in preparation. As distinguished from refuse, the waste includes the edible portions of food, as pieces of meat, bread, etc., which might be saved and utilized, but are actually thrown away with the refuse.

In the studies here reported the refuse and the waste were separated as completely as practicable, and the latter was collected and either dried and analyzed, or the nutrients calculated from the weights and assumed percentage composition of the different food materials making up the waste.

The table following shows the percentage of nutrients in some of the food materials used in some of the dietaries here reported. The majority of these percentages were calculated from the weights and composition of the raw ingredients used in preparing the foods.

* The Chemical Composition of American Food Materials. By W. O. Atwater and A. P. Bryant.

TABLE 14.

Percentage of nutrients in some of the food materials used in the following dietaries:

Ref. No.	FOOD MATERIALS.	Protein.	Fat.	Carbohydrates.
	Animal Food.	%	%	%
1	Beef,	32.5	2.2	—
2	Gravy,	1.9	.2	12.5
3	Corned beef hash,	9.6	6.0	12.0
4	Scramble,	8.8	7.7	11.8
5	Soup,	2.6	.7	4.7
6	Soup,	7.0	3.6	9.1
7	Ham,	13.6	33.4	—
8	Cod, salt (stewed),	8.0	7.8	21.6
9	Cod, creamed,	11.0	.9	3.0
10	Soup (dried residue),	29.7	27.7	35.5
11	Butter,	1.1	86.2	—
12	Milk,	3.4	4.4	4.8
	Vegetable Food.			
13	Wheatlet, cooked,	2.8	.5	11.5
14	Wheat, cooked,	2.0	.3	12.8
15	Cornmeal mush,	1.4	.4	11.4
16	Oatmeal mush,	2.5	1.1	9.9
17	Rice, boiled,	1.7	.1	17.1
18	Bread, corn,	8.5	2.7	47.3
19	Bread, ginger,	5.4	9.5	64.7
20	Bread, graham,	8.6	1.3	54.3
21	Bread, wheat,	9.4	1.2	53.2
22	Bread,	8.4	2.0	47.5
23	Wheat breakfast food,	11.4	.6	80.4
24	Biscuit, raised,	8.4	6.5	53.9
25	Spaghetti,	11.8	1.6	73.1
26	Cake, tea,	7.1	9.0	68.5
27	Cookies, ginger,	5.8	6.2	80.8
28	Ginger snaps,	5.9	8.7	77.7
29	Cookies, molasses,	7.2	8.7	75.7
30	Cookies, sugar,	7.1	9.9	74.4
31	Doughnuts,	6.7	21.6	53.9
32	Doughnuts,	6.6	23.3	46.7
33	Griddle cakes,	13.0	6.0	35.7
34	Pie, peach,	4.1	9.9	37.8
35	Pudding, bread,	3.2	2.0	14.7
36	Pudding, bread,	3.4	4.4	19.0
37	Pudding, bread,	4.8	5.2	22.5
38	Pudding, Indian meal,	1.8	3.8	16.5
39	Pudding, rice,	1.8	.6	21.6
40	Pudding, rice,	3.1	2.7	13.4
41	Pudding, tapioca,	3.8	3.0	25.3
42	Pudding, tapioca,	1.7	4.3	19.6
43	Custard,	4.0	4.1	20.8
44	Fish dressing,	6.9	13.7	36.8
45	Rock candy,	—	—	100.0
46	Cocoa,	1.2	1.6	9.0
47	Peach sauce,	1.5	.3	29.9
48	Prune sauce,	1.1	—	40.1
49	Coffee jelly,	1.0	.1	27.1
50	Wet waste,	14.5	1.8	82.0

No. 316. DIETARY OF A COLLEGE STUDENT AT MIDDLETOWN, CONN.

This is the dietary of a college student, about 21 years of age, who boarded himself during a summer vacation, and for three weeks made careful record of all the food materials he used. His food, which he bought each day as needed, consisted largely of materials already cooked or otherwise prepared for eating. The proportion of vegetable food in this dietary is larger than usual, which is explained partly by his personal preference and partly by the fact that such food is obtainable in large variety ready for use. A quart of milk was used each day. Canned meats were purchased rather than fresh, because they required no cooking. The subject was in good health, weighed about 160 pounds at the beginning of the study, and gained slightly in weight during the study. He was engaged in mental work about eight hours a day, and rode from five to fifteen miles each day on his bicycle for exercise. The study is divided into three periods of one week each.

TABLE 15.

Cost and weights of food materials used in dietary No. 316.*

[*Quantities per man per day.*]

FOOD MATERIALS. ‡	Cost.	Weight.		FOOD MATERIALS. ‡	Cost.	Weight.	
FOOD PURCHASED. *Animal Food.*	$	Lbs.	Oz.	FOOD PURCHASED. *Vegetable Food (Con.)*	$	Lbs.	Oz.
Beef:				Cake, jelly, - -	.10	—	10.5
Steak, round, -	.39	2	2.5	Cookies, - -	.02	—	6.0
Roast, canned, -	.42	3	4.0	Cookies, fruit, -	.02	—	1.5
Dried, smoked, -	.15	—	7.5	Cream puffs, - -	.02	—	2.5
Corned, canned, -	.22	1	9.0	Ginger snaps, -	.08	—	12.0
Pork: Lard, - -	—	—	2.0	"Rusk," - -	.05	—	8.5
Fish: Salmon, canned,	.35	1	14.0	Sponge wafers, -	.18	1	10.0
Eggs, - - -	.54	3	6.0	Pie, huckleberry, -	.17	1	7.0
Butter, - - -	—	—	1.0	Pie, lemon, - -	.03	—	6.0
Milk, - - -	1.11	49	8.5	Pie, prune, - -	.10	1	—
Milk, condensed, -	.08	—	10.0	Sugar, - - -	.39	5	11.0
				Beans, baked, canned,	.58	11	7.5
Total animal food,	3.26	63	.5	Peas, canned, -	.04	—	9.5
				Catsup, - - -	.03	—	7.0
				Apples, - - -	—	—	1.0
Vegetable Food.				Bananas, - -	.15	1	14.5
Oatmeal, - -	—	—	12.0	Dates, - - -	.08	—	14.0
Rolls, - - -	.46	6	1.0	Plums, - - -	—	—	2.0
Biscuit, - - -	.15	1	13.5	Prunes, - - -	.04	—	3.5
Biscuit, shredded, -	.40	2	8.5	Ginger ale, - -	.10	—	7.0
Bread, - - -	.07	1	7.0				
Crackers, milk, -	.03	—	4.0	Total veg. food, -	3.37	41	14.5
Crackers, soda, -	.02	—	2.0	Total food, - -	6.63	105	6.0
Cakes, cup, - -	.06	—	8.5				

* All weights, unless otherwise specified, are of the edible material free from bone, skin, etc.

‡ The percentage composition of all materials used in this dietary was taken from Bulletin 28, of the Office of Experiment Stations of the U. S. Dept. of Agriculture.

TABLE 15.—*(Continued.)*

FOOD MATERIALS.	Cost.	Weight.		FOOD MATERIALS.	Cost.	Weight.	
FOOD WASTED. *Animal Food.*	$	Lbs.	Oz.	FOOD WASTED. *Vegetable Food.*	$	Lbs.	Oz.
Beef, corned, canned,	—	—	2.5	Beans, baked, canned,	—	1	12.0
Beef, roast, canned, -	—	—	7.0	Dates, - - -	—	—	5.5
Salmon, canned, -	—	—	2.0				
Eggs, - - -	—	—	2.0	Total veg. food, -	—	2	1.5
Milk, - - -	—	—	8.5				
				Total food, - -	—	3	7.5
Total animal food,	—	1	6.0				

TABLE 16.

Weights and percentages of food materials and nutritive ingredients used in dietary study No. 316, first period.

[*Quantities per man per day.*]

FOOD MATERIALS.	WEIGHTS.					PERCENTAGES OF TOTAL FOOD.				
	Food materials.	NUTRIENTS.			Fuel value.	Food materials.	NUTRIENTS.			Fuel value.
		Protein.	Fat.	Carbohydrates.			Protein.	Fat.	Carbohydrates.	
FOOD PURCHASED. *Animal Food.*	Gm.	Gm.	Gm.	Gm.	Cal.	%	%	%	%	%
Beef, veal, mutton, -	216	56	26	—	—	8.7	31.9	20.5	—	—
Pork, lard, etc., -	7	—	7	—	—	.3	—	5.6	—	—
Eggs, - - -	90	13	9	—	—	3.6	7.5	7.4	—	—
Butter, - - -	4	—	4	—	—	.2	—	2.9	—	—
Milk, - - -	985	32	40	49	—	39.5	18.4	30.8	8.2	—
Milk, condensed, -	41	4	3	22	—	1.7	2.0	2.7	3.7	—
Total animal food,	**1343**	**105**	**89**	**71**	**1530**	**54.0**	**59.8**	**69.9**	**11.9**	**35.0**
Vegetable Food.										
Cereals, - - -	485	39	28	299	—	19.5	22.3	21.7	49.5	—
Sugars and starches,	135	—	—	135	—	5.4	—	—	22.4	—
Vegetables, - -	492	31	11	91	—	19.8	17.7	8.4	15.0	—
Fruits, - - -	33	1	—	7	—	1.3	.2	—	1.2	—
Total veg. food, -	**1145**	**71**	**39**	**532**	**2835**	**46.0**	**40.2**	**30.1**	**88.1**	**65.0**
Total food, - -	**2488**	**176**	**128**	**603**	**4365**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
FOOD WASTED.										
Animal, - - -	—	2	2	1	30	—	1.3	1.6	.2	.7
Vegetable, - -	—	8	3	23	155	—	4.5	2.2	3.7	3.5
Total, - - -	—	**10**	**5**	**24**	**185**	—	**5.8**	**3.8**	**3.9**	**4.2**
FOOD ACTUALLY EATEN.										
Animal, - - -	—	103	83	74	1500	—	58.5	68.3	11.7	34.4
Vegetable, - -	—	63	36	509	2680	—	35.7	27.9	84.4	61.4
Total, - - -	—	**166**	**119**	**583**	**4180**	—	**94.2**	**96.2**	**96.1**	**95.8**

TABLE 17.

Weights and percentages of food materials and nutritive ingredients used in dietary study No. 316, second period.

[*Quantities per man per day.*]

FOOD MATERIALS.	WEIGHTS.					PERCENTAGES OF TOTAL FOOD.				
	Food materials.	NUTRIENTS.			Fuel value.	Food materials.	NUTRIENTS.			Fuel value.
		Protein.	Fat.	Carbohydrates.			Protein.	Fat.	Carbohydrates.	
FOOD PURCHASED.	Gm.	Gm.	Gm.	Gm.	Cal.	%	%	%	%	%
Animal Food.										
Beef, veal, mutton, -	164	42	36	—	—	6.8	26.2	27.7	—	—
Fish, etc., - -	65	14	8	—	—	2.7	8.9	6.0	—	—
Eggs, - - -	85	13	9	—	—	3.5	7.9	6.7	—	—
Milk, - - -	1155	38	46	58	—	47.9	23.9	35.0	10.9	—
Total animal food,	**1469**	**107**	**99**	**58**	**1595**	**60.9**	**66.9**	**75.4**	**10.9**	**39.3**
Vegetable Food.										
Cereals, - - -	401	31	24	247	—	16.6	19.4	17.8	46.6	—
Sugar and starches, -	101	—	—	101	—	4.2	—	—	19.1	—
Vegetables, - -	285	20	7	56	—	11.8	12.3	5.4	10.5	—
Fruits, - - -	128	2	2	65	—	5.3	1.4	1.4	12.3	—
Total veg. food, -	**915**	**53**	**33**	**469**	**2450**	**37.9**	**33.1**	**24.6**	**88.5**	**60.4**
Unclassified, -	29	—	—	3	10	1.2	—	—	.6	.3
Total food, - -	**2413**	**160**	**132**	**530**	**4055**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
FOOD WASTED.										
Animal, - - -	—	7	4	—	65	—	4.6	3.3	.1	1.6
Vegetable, - -	—	1	1	18	90	—	.3	.5	3.4	2.2
Total, - - -	—	**8**	**5**	**18**	**155**	—	**4.9**	**3.8**	**3.5**	**3.8**
FOOD ACTUALLY EATEN.										
Animal, - - -	—	100	95	58	1530	—	62.2	72.1	10.8	37.7
Vegetable, - -	—	52	32	451	2360	—	32.9	24.1	85.1	58.2
Unclassified, - -	—	—	—	3	10	—	—	—	.6	.3
Total, - - -	—	**152**	**127**	**512**	**3900**	—	**95.1**	**96.2**	**96.5**	**96.2**

TABLE 18.

Weights and percentages of food materials and nutritive ingredients used in dietary study No. 316, third period.

[*Quantities per man per day.*]

FOOD MATERIALS.	WEIGHTS.					PERCENTAGES OF TOTAL FOOD.				
	Food materials.	NUTRIENTS.			Food value.	Food materials.	NUTRIENTS.			Fuel value.
		Protein.	Fat.	Carbo-hydrates.			Protein.	Fat.	Carbo-hydrates.	
FOOD PURCHASED.	Gm.	Gm.	Gm.	Gm.	Cal.	%	%	%	%	%
Animal Food.										
Beef, veal, mutton, -	102	27	19	—	—	5.3	22.1	18.6	—	—
Fish, etc., - -	58	13	7	—	—	3.0	10.4	6.8	—	—
Eggs, - - -	45	7	5	—	—	2.4	5.5	4.6	—	—
Milk, - - -	1072	35	43	54	—	55.3	29.1	41.5	11.4	—
Total animal food,	**1277**	**82**	**74**	**54**	**1245**	**66.0**	**67.1**	**71.5**	**11.4**	**36.7**
Vegetable Food.										
Cereals, - - -	449	37	28	268	—	23.2	30.6	27.4	56.7	—
Sugars and starches,	135	—	—	135	—	7.0	—	—	28.6	—
Vegetables, - -	33	2	1	6	—	1.7	1.8	.8	1.4	—
Fruits, - - -	42	1	—	9	—	2.1	.5	.3	1.9	—
Total veg. food, -	**659**	**40**	**29**	**418**	**2150**	**34.0**	**32.9**	**28.5**	**88.6**	**63.3**
Total food, - -	**1936**	**122**	**103**	**472**	**3395**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
FOOD WASTED.										
Animal, - - -	—	**4**	**3**	—	**45**	—	**3.5**	**2.8**	—	**1.3**
FOOD ACTUALLY EATEN.										
Animal, - - -	—	78	71	54	1220	—	63.6	68.7	11.4	35.9
Vegetable, - -	—	40	29	418	2130	—	32.9	28.5	88.6	62.8
Total, - - -	—	**118**	**100**	**472**	**3350**	—	**96.5**	**97.2**	**100.0**	**98.7**
Average of 3 periods,	—	**145**	**115**	**522**	**3810**	—	—	—	—	—

No. 317. DIETARY OF A CHEMIST'S FAMILY AT MIDDLETOWN, CONN.

This dietary study of a professional man's family was carried on for the purpose of testing the practicability of substituting salt fish and dried legumes as sources of protein in a diet where ordinarily considerable quantities of meats were used. Salt cod fish was used in various preparations, and dried beans were made into "baked beans," bean soup and "old-fashioned bean porridge." In all other respects the diet was the same as usual, differing, however, from many dietaries in the large amount of dairy products, especially butter and milk, which were used. The study began with breakfast, November 8, 1899, and continued 9 days, with 27 meals. The family consisted of one man, 31 years of age, weighing 155 pounds; one woman, 29 years of age, weighing 120 pounds; and one boy, 5 years old, weighing about 45 pounds. The number of meals taken were as follows:

One man, - - - - - - - - - -	27 meals.
One woman (27 x .8 meal of man), equivalent to -	22 meals.
One boy (27 x .4 meal of man), equivalent to - -	11 meals.
Total number of meals equivalent to - - -	60 meals.
Equivalent to one man 20 days.	

TABLE 19.

Cost and weights of food materials used in dietary No. 317.*

FOOD MATERIALS. †	Cost.	Weight.		FOOD MATERIALS. †	Cost.	Weight.	
FOOD PURCHASED.	$	Lbs.	Oz.	FOOD PURCHASED.	$	Lbs.	Oz.
Animal Food.				*Vegetable Food (Con.)*			
Beef, shoulder, clod, -	.34	2	13.0	Molasses, - -	.07	—	13.5
Salt pork, - - -	.04	—	7.0	Maple syrup, - -	.02	—	2.0
Lard, - - -	.03	—	5.5	Sugar, - - -	.16	2	9.0
Cod, boned, - -	.20	2	6.5	Beans, dried, - -	.15	2	8.0
Oysters, solids, - -	.18	1	1.0	Potatoes, - - -	.05	4	3.0
Eggs, - - -	.19	1	1.0	Sweet potatoes, -	.07	4	3.5
Butter, - - -	.69	2	14.0	Apples, - - -	.14	10	6.0
Cheese, - - -	.07	—	7.0	Grapes, § - -	.04	1	9.0
Milk, - - -	.97	34	14.5	Grape preserves, -	.06	—	7.0
Cream, - - -	.09	—	12.0	Peaches, canned, -	.13	1	—
Total animal food, -	2.80	47	1.5	Chestnuts, § - -	.05	—	8.0
Vegetable Food.				English walnuts, § -	.02	—	4.0
Corn meal, - -	.02	—	13.0	Total veg. food, -	1.37	36	12.5
Rye meal, - - -	.01	—	9.0	Total food, - -	4.17	83	14.0
Wheat flour, - -	.12	3	13.5				
Wheatlet, - - -	.08	1	2.0	FOOD WASTED.			
Shredded wheat, -	.07	—	7.0	*Animal Food.*			
Bread, wheat, - -	.02	—	9.0	Beef, shoulder, clod,	—	—	.5
Crackers, milk, - -	.02	—	3.5	Milk, - - -	—	—	.5
Crackers, oyster, -	.05	—	7.5	Total animal food,	—	—	1.0
Cornstarch, - -	.02	—	3.0				

* All weights, unless otherwise specified, are of edible material free from bone, skins, etc.

† The percentage composition of the materials used in this dietary was taken from Bulletin 28, of the Office of Experiment Stations of the U. S. Dept. of Agriculture.

§ As purchased.

TABLE 19.—*(Continued.)*

FOOD MATERIALS.	Cost.	Weight.		FOOD MATERIALS.	Cost.	Weight.	
FOOD WASTED. *Vegetable Food.*	$	Lbs.	Oz.	FOOD WASTED. *Vegetable Food (Con.)*	$	Lbs.	Oz.
Flour,	—	—	2.0	Beans, baked,	—	—	.5
Bread, brown,	—	—	1.3	Sweet potatoes,	—	—	.5
Bread, wheat,	—	—	.2	Total veg. food,	—	—	6.5
Wheatlet, cooked, *	—	—	2.0	Total food,	—	—	7.5

* See Ref. No. 13, Table 14.

TABLE 20.

Weights and percentages of food materials and nutritive ingredients used in dietary study No. 317.

[*Quantities per man per day.*]

FOOD MATERIALS.	WEIGHTS.				Fuel value.	PERCENTAGES OF TOTAL FOOD.				Fuel value.
	Food materials.	NUTRIENTS.				Food materials.	NUTRIENTS.			
		Protein.	Fat.	Carbohydrates.			Protein.	Fat.	Carbohydrates.	
FOOD PURCHASED.	Gm.	Gm.	Gm.	Gm.	Cal.	%	%	%	%	%
Animal Food.										
Beef, veal, mutton,	64	13	7	—	—	3.4	12.4	5.6	—	—
Pork, lard, etc.,	18	—	16	—	—	.9	.2	12.4	—	—
Fish,	79	15	1	1	—	4.1	15.3	.3	.3	—
Eggs,	24	3	2	—	—	1.2	3.5	1.9	—	—
Butter,	65	1	56	—	—	3.5	.6	42.9	—	—
Cheese,	10	3	3	—	—	.5	2.6	2.7	—	—
Milk,	791	26	32	39	—	41.6	25.9	24.4	10.1	—
Cream,	17	—	3	1	—	.9	.4	2.4	.3	—
Total animal food,	1068	61	120	41	1535	56.1	60.9	92.6	10.7	49.8
Vegetable Food.										
Cereals,	183	20	4	135	—	9.6	19.9	3.2	35.2	—
Sugars and starches,	84	1	—	77	—	4.4	.4	—	20.0	—
Vegetables,	246	17	2	77	—	13.0	16.3	1.4	20.0	—
Fruits,	321	2	4	54	—	16.9	2.5	2.8	14.1	—
Total veg. food,	834	40	10	343	1665	43.9	39.1	7.4	89.3	50.2
Total food,	1902	101	130	384	3200	100.0	100.0	100.0	100.0	100.0
FOOD WASTED.										
Vegetable,*	—	1	—	4	20	—	.6	—	1.0	.6
FOOD ACTUALLY EATEN.										
Animal,	—	61	120	41	1535	—	60.9	92.6	10.7	49.8
Vegetable,	—	39	10	339	1645	—	38.5	7.4	88.3	49.6
Total,	—	100	130	380	3180	—	99.4	100.0	99.0	99.4

* The quantity of animal food wasted was too small to affect the final results per man per day.

No. 318. DIETARY OF A COLLEGE STUDENT AT MIDDLETOWN, CONN.

This study began with breakfast, December 5, 1899, and continued 6 days, with 18 meals. The subject was a college student about 20 years of age, and weighing 170 pounds. He was something of an athlete, and was taking active exercise in the gymnasium daily, besides more or less active exercise out of doors. For further description of this study, see page 125.

TABLE 21.

Weights of food materials consumed in dietary No. 318.*

FOOD MATERIALS.	Ref. No.‡	Weight.		FOOD MATERIALS.	Ref. No.‡	Weight.	
FOOD CONSUMED.		Lbs.	Oz.	FOOD CONSUMED.		Lbs.	Oz.
Animal Food.				*Vegetable Food (Con.)*			
Beef:				Oatmeal, boiled, -	—	1	14.5
Boiled, - - -	—	—	7.0	Pie, apple, - -	—	—	4.5
Corned, cooked, -	—	—	7.5	Pudding, bread, -	37	—	4.0
Corned, hash, -	—	—	15.0	Rice, boiled, - -	—	1	—
Gravy, - - -	2	—	6.5	Wheat, cooked, -	14	1	2.5
Loin steak, broiled,	—	—	4.5	Cocoa, - - -	46	—	6.0
Pork, loin, fried, -	—	—	4.0	Sugar, - - -	—	—	9.0
Fish, clam chowder, -	—	—	17.0	Tapioca pudding, -	—	—	4.0
Butter, - - -	—	—	12.5	Beans, baked, - -	—	—	5.0
Milk, - - -	—	14	1.5	Cabbage, cooked, -	—	—	3.5
				Cabbage, chopped, -	—	—	1.5
Total animal food, -	—	**18**	**11.5**	Potatoes, cooked, -	—	3	10.5
				Apples, - - -	—	—	9.5
Vegetable Food.				Apple sauce, - -	—	—	4.0
Bread, brown, - -	—	1	6.5	Apples, baked, -	—	—	3.5
Bread, corn, - -	—	—	5.0	Cranberry sauce, -	—	—	3.5
Bread, wheat, - -	—	4	11.0	Jelly, coffee, - -	49	—	2.5
Biscuit, graham, -	—	—	5.5				
Biscuit, shredded, -	—	—	2.0	Total veg. food, -	—	**19**	**14.0**
Cake, layer, - -	—	—	4.5				
Dumplings, apple, -	—	—	8.5	Total food, - -	—	**38**	**9.5**
Gems, wheat, - -	—	—	11.0				

* All weights are of edible material.

‡ See pp. 126 and 127.

TABLE 22.

Weights and percentages of food materials and nutritive ingredients consumed in dietary study No. 318.

[*Quantities per man per day.*]

FOOD MATERIALS.	WEIGHTS.					PERCENTAGES OF TOTAL FOOD.				
	Food materials.	NUTRIENTS.			Fuel value.	Food materials.	NUTRIENTS.			Fuel value.
		Protein.	Fat.	Carbohydrates.			Protein.	Fat.	Carbohydrates.	
FOOD PURCHASED.	Gm.	Gm.	Gm.	Gm.	Cal.	%	%	%	%	%
Animal Food.										
Beef, veal, mutton, -	191	28	16	11	—	6.5	20.4	11.6	1.8	—
Pork, lard, etc., -	19	3	6	—	—	.6	2.3	4.1	—	—
Fish, - - -	81	2	1	5	—	2.8	1.1	.5	.9	—
Butter, - - -	60	1	51	—	—	2.1	.3	37.0	—	—
Milk, - - -	1064	35	42	53	—	36.5	25.2	30.8	8.8	—
Total animal food,	**1415**	**69**	**116**	**69**	**1645**	**48.5**	**49.3**	**84.0**	**11.5**	**38.1**
Vegetable Food.										
Cereals, - - -	981	60	19	388	—	33.6	43.2	14.0	64.6	—
Sugars and starches,	89	1	1	50	—	3.0	.7	.7	8.3	—
Vegetables, - -	325	9	1	64	—	11.2	6.5	.7	10.6	—
Fruits, - - -	107	—	1	30	—	3.7	.3	.6	5.0	—
Total veg. food, -	**1502**	**70**	**22**	**532**	**2670**	**51.5**	**50.7**	**16.0**	**88.5**	**61.9**
Total food, - -	**2917**	**139**	**138**	**601**	**4315**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

No. 319. DIETARY OF A COLLEGE STUDENT AT MIDDLETOWN, CONN.

This study began with breakfast, December 5, 1899, and continued 6 days, with 18 meals. The subject was a college student, about 20 years of age, and weighing about 160 pounds. He took no especially active exercise. For further description of this study, see page 125.

TABLE 23.

Weights of food materials used in dietary No. 319.*

FOOD MATERIALS.	Ref. No.‡	Weight.		FOOD MATERIALS.	Ref. No.‡	Weight.	
FOOD PURCHASED.		Lbs.	Oz.	FOOD PURCHASED.		Lbs.	Oz.
Animal Food.				*Vegetable Food (Con.)*			
Beef:				Crackers, - -	—	—	9.0
Boiled, - - -	—	—	5.5	Dumplings, apple, -	—	—	5.0
Corned, cooked, -	—	—	5.0	Gems, wheat, - -	—	—	4.5
Chopped, cooked, -	—	—	2.5	Oatmeal, boiled, -	—	2	10.0
Corned, hash, -	—	—	11.5	Pie, apple, - -	—	—	6.5
Gravy, - - -	2	—	4.0	Rice, boiled, - -	—	—	7.5
Loin steak, broiled,	—	—	3.5	Wheat, cooked, -	14	—	5.5
Pork, loin, fried, -	—	—	3.5	Sugar, - - -	—	—	6.5
Fish, clam chowder, -	—	—	11.0	Cocoa, - - -	46	—	7.0
Butter, - - -	—	—	10.0	Tapioca pudding, -	—	—	3.5
Milk, - - -	—	3	13.5	Beans, baked, - -	—	—	10.5
				Cabbage, cooked, -	—	—	4.5
Total animal food, -	—	7	6.0	Cabbage, chopped, -	—	—	2.5
				Potatoes, cooked, -	—	1	12.5
Vegetable Food.				Potatoes, creamed, -	—	—	4.5
Bread, brown, - -	—	—	8.0	Apple sauce, - -	—	—	3.0
Bread, corn, - -	—	—	7.0	Apples, baked, -	—	—	10.5
Bread, graham, - -	—	—	10.5	Cranberry sauce, -	—	—	3.5
Bread, wheat, - -	—	1	11.0	Jelly, coffee, - -	49	—	5.0
Biscuit, graham, -	—	—	7.0	Total veg. food, -	—	15	1.5
Biscuit, shredded, -	—	—	1.0				
Biscuit, wheat, - -	—	—	8.5	Total food, - -	—	22	7.5
Cake, layer, - -	—	—	3.0				

* All weights are of edible material.

‡ See pp. 126 and 127.

TABLE 24.

Weights and percentages of food materials and nutritive ingredients consumed in dietary study No. 319.

[*Quantities per man per day.*]

FOOD MATERIALS.	WEIGHTS.					PERCENTAGES OF TOTAL FOOD.				
		NUTRIENTS.					NUTRIENTS.			
	Food materials.	Protein.	Fat.	Carbohydrates.	Fuel value.	Food materials.	Protein.	Fat.	Carbohydrates.	Fuel value.
FOOD CONSUMED.	Gm.	Gm.	Gm.	Gm.	Cal.	%	%	%	%	%
Animal Food.										
Beef, veal, mutton, -	151	24	13	7	—	8.9	26.8	12.9	1.8	—
Pork, lard, etc., -	16	3	5	—	—	1.0	3.0	5.1	—	—
Fish, etc., - -	52	1	—	—	—	3.1	1.1	.3	.8	—
Butter, - - -	47	—	40	3	—	2.8	.5	40.8	—	—
Milk, - - -	291	10	12	15	—	17.1	10.5	11.8	3.4	—
Total animal food,	**557**	**38**	**70**	**25**	**910**	**32.9**	**41.9**	**70.9**	**6.0**	**30.2**
Vegetable Food.										
Cereals, - -	718	44	24	277	—	42.3	48.0	24.9	65.5	—
Sugars and starches,	80	1	1	37	—	4.7	1.1	1.2	8.9	—
Vegetables, - -	237	8	2	44	—	14.0	8.6	2.2	10.3	—
Fruits, - - -	104	—	1	39	—	6.1	.4	.8	9.3	—
Total veg. food, -	**1139**	**53**	**28**	**397**	**2105**	**67.1**	**58.1**	**29.1**	**94.0**	**69.8**
Total food, - -	**1696**	**91**	**98**	**422**	**3105**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

No. 320. DIETARY OF A COLLEGE STUDENT AT MIDDLETOWN, CONN.

This study began with breakfast, December 5, 1899, and continued 6 days, with 18 meals. The subject was a college student, about 20 years of age, and weighing about 175 pounds. He was taking moderate exercise daily. For further description of this study, see page 125.

TABLE 25.

Weights of food materials used in dietary No. 320.*

FOOD MATERIALS.	Ref. No.‡	Weight.		FOOD MATERIALS.	Ref. No.‡	Weight.	
FOOD CONSUMED.		Lbs.	Oz.	FOOD CONSUMED.		Lbs.	Oz.
Animal Food.				*Vegetable Food (Con.)*			
Beef:				Cake, layer, - -	—	—	8.0
Boiled, - - -	—	—	6.5	Crackers, - -	—	—	2.0
Corned, cooked, -	—	—	7.5	Dumpling, apple, -	—	—	7.5
Corned, hash, -	—	—	15.0	Oatmeal, - - -	—	2	3.5
Gravy, - - -	2	—	3.0	Pie, apple, - -	—	—	6.5
Loin steak, broiled,	—	—	3.5	Rice, boiled, - -	—	—	12.5
Pork, loin, fried, -	—	—	1.5	Cocoa, - - -	46	—	4.5
Fish, etc., clam chowder,	—	—	13.0	Sugar, - - -	—	—	9.0
Butter, - - -	—	—	7.0	Tapioca pudding, -	—	—	4.5
Milk, - - -	—	10	13.5	Beans, baked, -	—	—	7.0
				Cabbage, cooked, -	—	—	4.0
Total animal food, -	—	**14**	**6.5**	Potatoes, cooked, -	—	1	6.5
				Apples, - - -	—	—	2.5
Vegetable Food.				Apples, baked, -	—	—	8.5
Bread, brown, - -	—	—	4.0	Apple sauce, - -	—	—	3.0
Bread, graham, - -	—	2	—	Jelly, coffee, - -	49	—	3.0
Bread, wheat, - -	—	—	25.0				
Biscuit, shredded, -	—	—	6.0	Total veg. food, -	—	**13**	**2.0**
Custard, - - -	43	—	2.5	Total food, - -	—	**27**	**8.5**

* All weights are of edible material.

‡ See pp. 126 and 127.

TABLE 26.

Weights and percentages of food materials and nutritive ingredients consumed in dietary study No. 320.

[*Quantities per man per day.*]

FOOD MATERIALS.	WEIGHTS.					PERCENTAGES OF TOTAL FOOD.				
		NUTRIENTS.					NUTRIENTS.			
	Food materials.	Protein.	Fat.	Carbohydrates.	Fuel value.	Food materials.	Protein.	Fat.	Carbohydrates.	Fuel value.
FOOD CONSUMED.	Gm.	Gm.	Gm.	Gm.	Cal.	%	%	%	%	%
Animal Food.										
Beef, veal, mutton, -	168	27	15	8	—	8.0	25.4	15.0	2.0	—
Pork, - - -	7	1	2	—	—	.3	1.1	2.2	—	—
Fish, - - -	61	1	—	4	—	3.0	1.1	.5	.9	—
Butter, - - -	33	—	28	—	—	1.6	.3	28.6	—	—
Milk, - - -	820	27	33	41	—	39.4	26.1	33.6	9.6	—
Total animal food,	1089	56	78	53	1175	52.3	54.0	79.9	12.5	38.1
Vegetable Food.										
Cereals, - - -	671	41	17	269	—	32.2	39.7	17.6	63.0	—
Sugars and starches,	84	1	1	49	—	4.0	1.0	1.0	11.5	—
Vegetables, - -	158	5	1	30	—	7.6	5.2	1.0	7.0	—
Fruits, - - -	80	1	1	25	—	3.9	.1	.5	6.0	—
Total veg. food, -	993	48	20	373	1910	47.7	46.0	20.1	87.5	61.9
Total food, - -	2082	104	98	426	3085	100.0	100.0	100.0	100.0	100.0

No. 321. DIETARY OF A CHEMIST AT MIDDLETOWN, CONN.

This study began with breakfast, January 14, 1900, and continued 3 days, with 9 meals. The subject (J. F. S.) was a chemist, 29 years of age, weighing 145 pounds. The study was made for the purpose of obtaining data on which to base a ration for use in experiments with the subject in the respiration calorimeter. The kinds of food in the diet were the same as would be given him in such experiments, but the amounts consumed were to be determined by his appetite. The composition of the food materials used in this dietary was known with considerable accuracy, so that the figures in the following tables give reliable data concerning the actual nutrients in the food consumed by the subject during this period.

TABLE 27.

Weights of food materials used in dietary No. 321.

Food Materials.	Ref. No.*	Weight.		Food Materials.	Ref. No.*	Weight.	
		Lbs.	Oz.			Lbs.	Oz.
Animal Food.				*Vegetable Food.*			
Beef,	1	—	12	Bread,	22	2	4.0
Butter,	11	—	7	Parched cereals,	23	—	7.5
Milk,	12	8	12	Ginger snaps,	28	—	7.5
Total animal food,	—	9	15	Rock candy,	45	—	4.5
				Sugar,	—	—	1.5
				Total veg. food,	—	3	9.0
				Total food,	—	13	8.0

* See pp. 126 and 127.

TABLE 28.

Weights and percentages of food materials and nutritive ingredients consumed in dietary study No. 321.

[*Quantities per man per day.*]

Food Materials.	Weights.				Fuel value.	Percentages of Total Food.				Fuel value.
	Food materials.	Nutrients.				Food materials.	Nutrients.			
		Protein.	Fat.	Carbohydrates.			Protein.	Fat.	Carbohydrates.	
Food Consumed.	Gm.	Gm.	Gm.	Gm.	Cal.	%	%	%	%	%
Animal Food.										
Beef,	113	37	3	—	—	5.5	29.1	1.9	—	—
Butter,	69	3	64	—	—	3.4	2.7	46.1	—	—
Milk,	1322	45	58	64	—	64.7	35.4	42.3	16.1	—
Total animal food,	1504	85	125	64	1775	73.6	67.2	90.3	16.1	51.9
Vegetable Food.										
Cereals,	485	41	13	275	—	23.7	32.8	9.7	69.7	—
Sugars, etc.,	56	—	—	56	—	2.7	—	—	14.2	—
Total veg. food,	541	41	13	331	1645	26.4	32.8	9.7	83.9	48.1
Total food,	2045	126	138	395	3420	100.0	100.0	100.0	100.0	100.0

No. 322. DIETARY OF A COLLEGE STUDENT AT MIDDLETOWN, CONN.

The subject of this study was the same as in dietary study No. 316, on a preceding page. The study began on January 4, 1900, and continued 3 days, with 9 meals. The conditions and purpose of the study were the same as given for the study of the dietary of a chemist, No. 321.

TABLE 29.

Weights of food materials used in dietary No. 322.

FOOD MATERIALS.	Ref. No.*	Weight.		FOOD MATERIALS.	Ref. No.*	Weight.	
FOOD CONSUMED. *Animal Food.*		Lbs.	Oz.	FOOD CONSUMED. *Vegetable Food.*		Lbs.	Oz.
Beef,	1	1	11.5	Bread,	22	3	6.5
Butter,	11	—	8.0	Graham crackers,	—	—	3.0
Milk,	12	13	15.5	Parched cereals,	23.	—	8.5
Total animal food,	—	16	3.0	Sugar,	—	—	1.0
				Cocoa,	—	—	4.0
				Total veg. food,	—	4	7.0
				Total food,	—	20	10.0

* See pp. 126 and 127.

TABLE 30.

Weights and percentages of food materials and nutritive ingredients consumed in dietary study No. 322.

[*Quantities per man per day.*]

FOOD MATERIALS.	WEIGHTS.				Fuel value.	PERCENTAGES OF TOTAL FOOD.				Food value.
	Food materials.	NUTRIENTS.				Food materials.	NUTRIENTS.			
		Protein.	Fat.	Carbohydrates.			Protein.	Fat.	Carbohydrates.	
FOOD CONSUMED. *Animal Food.*	Gm.	Gm.	Gm.	Gm.	Cal.	%	%	%	%	%
Beef,	195	63	4	—	—	8.4	39.6	3.2	—	—
Butter,	57	1	49	—	—	2.4	.4	36.2	—	—
Milk,	1584	54	70	76	—	67.8	33.5	51.5	21.7	—
Total animal food,	1836	118	123	76	1940	78.6	73.5	90.9	21.7	57.9
Vegetable Food.										
Cereals,	462	41	10	243	—	19.8	25.4	7.4	69.3	—
Sugars, etc.,	37	1	2	32	—	1.6	1.1	1.7	9.0	—
Total veg. food,	499	42	12	275	1410	21.4	26.5	9.1	78.3	42.1
Total food,	2335	160	135	351	3350	100.0	100.0	100.0	100.0	100.0

DIETARY STUDIES IN THE CONNECTICUT HOSPITAL FOR THE INSANE.

By W. O. Atwater.

The importance of more thorough study of the dietaries of public institutions is coming to be generally felt. The number of charitable institutions and the number of persons supported in them at the expense of the community are already large and rapidly increasing. The philanthropy of to-day demands that the welfare of the inmates shall be most carefully considered. The cost to the taxpayer requires the closest economy consistent with their welfare.

In the home, on the farm, in the factory, in commercial establishments, on railroads, in municipal enterprises, indeed, almost everywhere, the results of scientific research are being put to practical use. It would seem that they ought to be capable of being utilized in the dietetic management of public institutions. The probability of their successful application here is rendered all the greater by the fact that during the past few decades a very large amount of scientific inquiry, and that of the highest order, has been devoted to the studies of food and nutrition.

Appreciating these considerations, the New York State Commission in Lunacy has instituted an inquiry into the dietetic management of the hospitals for the insane in that State. This inquiry has been placed under the general direction of the writer. Accounts of the progress of the inquiry have been furnished for publication in the tenth and eleventh annual reports of the Commission.

In the belief that studies of dietaries in the Connecticut Hospital for the Insane would be of interest, advantage was taken of an opportunity offered for such study through the courtesy of Dr. C. W. Page, Superintendent of that institution, and Dr. J. M. Keniston of the medical staff, to whom

especial thanks are also due for important assistance in carrying out the details. Studies were made in two of the buildings in November, 1898, and are here reported. The statistics were gathered by Messrs. A. P. Bryant, H. C. Sherman, and H. E. Wells. The methods of dietary study ordinarily followed by the Station were necessarily modified somewhat in making these two studies. The modifications have been explained on page 125 in the general description of methods given in the preceding article. The tables on pages 145–149 contain the data of these two studies.

I regret that the resources at the disposal of the Station for such investigations have not been sufficient to carry this inquiry further. The results obtained, however, compared with those obtained from the information available from other sources, were such as seemed to warrant a statement to Dr. Page, of which the following is a copy:

MIDDLETOWN, CONN., January 26, 1899.

C. W. Page, M. D., Superintendent, Connecticut Hospital for the Insane, Middletown, Conn.:

MY DEAR SIR:—The results of the dietary studies lately made in your institution are of decided interest. Although they were made in only two of the buildings and continued for but a short time, I see no reason why they should not more or less fairly represent the usage of the establishment as a whole. From the physiological standpoint the diet in the cases studied was ample in quantity; there was, I should say, an excess rather than a deficiency of nutritive ingredients, and the food was in every way wholesome and nutritious. The relative waste was considerably larger at the main building with twenty dining rooms than at the middle building with one large and three very small dining rooms. I think the hospital is to be congratulated upon the success in the feeding of its patients.

Very truly yours,

(Signed) W. O. ATWATER.

I hope there may be opportunity hereafter for further studies such as will warrant more general conclusions. Meanwhile, I think it is safe to say that although the figures given show considerable quantities of waste, these latter are no larger—indeed, they are smaller—than are often found in well managed institutions elsewhere. They indicate that the dietetic management in the Connecticut State Hospital is such as to provide for excellent nourishment at a comparatively low cost. The amounts of food actually eaten per person per day,

as shown by these two studies, are on the whole somewhat larger than the average amounts per person per day eaten by a much larger number of people in New York hospitals whose dietaries were studied. While this fact has less significance than it would have if the studies at the Connecticut Hospital were more numerous, it implies, so far as it goes, that the patients in our institution were liberally fed. The same inference may, I think, be drawn from comparisons with the results of other dietary studies and with dietary standards.

In conclusion, I may say that in my judgment a careful and extensive study of this general subject in the public and charitable institutions of Connecticut is much to be desired.

No. 253. DIETARY AT MIDDLE BUILDING OF THE CONNECTICUT HOSPITAL FOR THE INSANE.

The study began with breakfast, November 3, 1898, and continued 7 days. It was carried on in the part of the Hospital known as the "Middle Building," which accommodates about 400 patients. Most of the patients took their meals in the main dining room. A few, however, who for some reason were not able or were not allowed to eat with these, were served in small dining rooms in the wards. The study shows the amount of food consumed by the patients and the attendants. The patients were of the "quiet demented" sort, who were considered hopelessly insane; but few, if any, of them were violent. The number of persons included in this study is as follows:

	Men.	Women.	Total.
Patients,	184	205	389
Attendants and employés,	13	20	33
Total,	197	225	422

The total number of meals served was thus 8,862, equivalent to 2,954 persons for one day. But little is as yet known concerning the relative amounts of food required by men and women of the insane class, consequently no attempt has been made to calculate the equivalent number of men for one day, the final results being given per person per day.

TABLE 31.

Weights of food materials used in dietary No. 253.*

FOOD MATERIALS.	Ref. No.†	Weight.	
		Lbs.	Oz.
FOOD PURCHASED.			
Animal Food.			
Beef:			
Roast, - - -	—	90	3
Soup meat, - -	—	76	—
Steak, - - -	—	205	8
Corned, - -	—	331	4
Dried, - - -	—	26	8
Pork:			
Ham (boiled), -	—	118	3
Salt (fat), - -	—	18	—
Fish:			
Whitefish, - -	—	148	8
Cod, salt, - -	—	50	8
Oysters, - -	—	103	—
Eggs, - - -	—	53	10
Butter, - - -	—	173	—
Cheese, - - -	—	35	13
Milk,‡ - - -	—	1596	8
Total animal food,	—	**3000**	**9**
Vegetable Food.			
Barley, pearled, -	—	4	7
Corn meal, - -	—	43	8
Flour, pastry, - -	—	40	—
Oatmeal, - - -	—	25	—
Rice, - - -	—	20	10
Biscuit, raised, -	24	92	12
Biscuit, soda, - -	24	72	4
Bread, brown, - -	—	116	12
Bread, corn, - -	18	119	4
Bread, ginger, - -	19	92	—
Bread, graham, -	20	151	—
Bread, wheat, - -	21	2122	—
Crackers, soda, -	—	32	4
Spaghetti, - -	25	70	—
Cake, tea, - -	26	89	7
Cookies, ginger, -	27	51	4
Cookies, sugar, -	30	60	—
Doughnuts, - -	31	76	—
Pie, apple, - -	—	240	—
Pie, dried peach, -	34	121	10
Sugar, - - -	—	226	—
Molasses, - -	—	4	2
Sirup, - - -	—	50	4
Tapioca, - - -	—	19	8
Beans, dried, - -	—	89	—
Beets, - - -	—	80	—
FOOD PURCHASED.			
Vegetable Food (Con.)			
Cabbage, - -	—	207	12
Carrots, - - -	—	7	8
Celery, - - -	—	23	8
Onions, - - -	—	185	8
Potatoes, - -	—	260	—
Squash, - - -	—	208	—
Sweet potatoes, -	—	845	12
Turnips, - -	—	168	12
Apples, - - -	—	180	4
Prunes, dried, -	—	52	—
Raisins, - - -	—	6	7
Total veg. food, -	—	**6254**	**7**
Total food, - -	—	**9255**	—
FOOD WASTED.			
Animal Food.			
Beef:			
Roast, - -	—	11	7
Steak, - -	—	32	4
Corned, - -	—	15	12
Dried, - -	—	2	4
Pork: ham, - -	7	11	3
Fish:			
Whitefish, - -	—	17	8
Cod, creamed, -	9	16	—
Soup (dried residue),	10	32	—
Total animal food,	—	**138**	**6**
Vegetable Food.			
Corn meal, - -	—	7	9
Oatmeal, - -	—	16	8
Biscuit, soda, - -	24	4	—
Bread, brown, -	—	30	—
Bread, corn, - -	18	11	12
Bread, ginger, -	19	3	—
Bread, graham, -	20	8	12
Bread, wheat, -	21	241	8
Crackers, - -	—	1	—
Spaghetti, - -	25	23	9
Cake, tea, - -	26	2	4
Cookies, ginger, -	27	2	1
Cookies, sugar, -	30	1	—
Doughnuts, - -	31	—	8
Pie, apple, - -	—	10	7
Pie, dried peach, -	34	6	—

* All weights, unless otherwise specified, are of the edible material free from bone, skins, etc.

† See pp. 126 and 127.

‡ Twenty-six pounds of cream was taken from this milk for use elsewhere than in this dietary.

TABLE 31.—*(Continued.)*

FOOD MATERIALS.	Ref. No.†	Weight.		FOOD MATERIALS.	Ref. No.†	Weight.	
		Lbs.	Oz.			Lbs.	Oz.
FOOD WASTED. *Vegetable Food (Con.)*				FOOD WASTED. *Vegetable Food (Con.)*			
Pudding, bread, -	35	19	12	Squash, - - -	—	10	—
Pudding, rice, -	39	33	14	Sweet potatoes, -	—	131	—
Pudding, tapioca, -	41	30	—	Turnips, - -	—	15	3
Beans, dried, - -	—	12	9	Apples, - - -	—	7	4
Beets, - - -	—	15	7	Prunes, dried, -	—	7	14
Cabbage, - -	—	11	10	Wet waste, - -	50	58	5
Celery, - - -	—	7	10	Total veg. food, -	—	**774**	**12**
Onions, - - -	—	11	8	Total food, - -	—	**913**	**2**
Potatoes, - -	—	32	14				

† See pp. 126 and 127.

TABLE 32.

Weights and percentages of food materials and nutritive ingredients used in dietary study No. 253.

[*Quantities per person per day.*]

FOOD MATERIALS.	WEIGHTS.				Fuel value.	PERCENTAGES OF TOTAL FOOD.				Fuel value.
	Food materials.	NUTRIENTS.				Food materials.	NUTRIENTS.			
		Protein.	Fat.	Carbohydrates.			Protein.	Fat.	Carbohydrates.	
	Gm.	Gm.	Gm.	Gm.	Cal.	%	%	%	%	%
FOOD PURCHASED. *Animal Food.*										
Beef, veal, mutton, -	112	19	25	—	—	7.9	19.9	28.3	—	—
Pork, - - -	21	4	6	—	—	1.5	3.9	7.2	—	—
Fish, - - -	46	8	2	1	—	3.3	7.7	1.9	.2	—
Eggs, - - -	8	1	1	—	—	.6	1.2	.9	—	—
Butter, - - -	27	—	23	—	—	1.9	.3	25.3	—	—
Cheese, - - -	6	1	2	—	—	.3	1.5	2.1	—	—
Milk, - - -	241	8	9	12	—	16.9	8.2	10.1	2.8	—
Total animal food,	**461**	**41**	**68**	**13**	**855**	**32.4**	**42.6**	**75.8**	**3.0**	**28.6**
Vegetable Food.										
Cereals, - - -	559	47	20	305	—	39.4	48.5	22.2	71.0	—
Sugars and starches,	46	—	—	43	—	3.2	—	—	10.1	—
Vegetables, - -	319	8	2	62	—	22.4	8.6	1.8	14.5	—
Fruits, - - -	37	—	—	6	—	2.6	.3	.2	1.4	—
Total veg. food, -	**961**	**55**	**22**	**416**	**2135**	**67.6**	**57.4**	**24.2**	**97.0**	**71.4**
Total food, - -	**1422**	**96**	**90**	**429**	**2990**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
WASTE.										
Animal, - - -	—	4	4	2	60	—	4.4	4.7	.4	2.0
Vegetable, - -	—	8	2	50	255	—	8.2	2.1	11.6	8.5
Total, - - -	—	**12**	**6**	**52**	**315**	—	**12.6**	**6.8**	**12.0**	**10.5**
FOOD ACTUALLY EATEN.										
Animal, - - -	—	37	64	11	795	—	38.2	71.1	2.6	26.6
Vegetable, - -	—	47	20	366	1880	—	49.2	22.1	85.4	62.9
Total, - - -	—	**84**	**84**	**377**	**2675**	—	**87.4**	**93.2**	**88.0**	**89.5**

No. 254. DIETARY AT MAIN BUILDING OF THE CONNECTICUT HOSPITAL FOR THE INSANE.

This study was begun with breakfast, November 14, 1898, and continued 7 days. It was carried on in the part of the Hospital known as the "Main Building," which is somewhat larger than the "Middle Building." The method of this study was the same as that of the preceding. The number of persons included in this study is as follows:

	Men.	Women.	Total.
Patients,	268	285	553
Attendants and employés,	45	52	97
Total,*	313	337	650

The total number of meals served was 13,650, equivalent to 4,550 persons for one day.

TABLE 33.

Weights of food materials used in dietary No. 254.*

FOOD MATERIALS.	Ref. No.†	Weight.		FOOD MATERIALS.	Ref. No.†	Weight.	
FOOD PURCHASED. *Animal Food.*		Lbs.	Oz.	FOOD PURCHASED. *Vegetable Food.*		Lbs.	Oz.
Beef:				Barley,	—	7	8.0
Beef-tea meat,	—	147	4.5	Corn meal,	—	61	—
Diet steak,	—	52	13.5	Rice,	—	64	12.0
Hamburg steak,	—	209	8.0	Rolled oats,	—	36	—
Liver,	—	20	4.0	Flour, wheat,	—	80	—
Roast,	—	233	8.0	Bread, brown,	—	268	9.5
Steak,	—	187	9.0	Bread, corn,	18	206	—
Soup meat,	—	141	3.5	Bread, graham,	20	99	8.0
Corned,	—	455	8.5	Bread, wheat,	21	2761	4.0
Dried,	—	34	4.0	Biscuit, soda,	24	98	4.0
Pork:				Crackers, soda,	—	55	—
Ham,	—	305	4.5	Cake, tea,	26	124	—
Salt, fat,	—	40	1.0	Cookies, molasses,	29	113	12.0
Fish, etc.:				Cookies, sugar,	30	86	—
Cod, fresh,	—	211	8.0	Doughnuts,	32	146	—
Cod, salt,	—	62	4.0	Pie, apple,	—	653	1.5
Oysters,	—	179	4.0	Spaghetti,	25	44	9.5
Eggs,	—	220	13.0	Molasses,	—	119	12.0
Butter,	—	461	8.0	Sugar,	—	466	—
Cheese,	—	58	4.0	Tapioca,	—	31	8.0
Milk,	—	4796	4.0	Beans,	—	265	9.0
				Cabbage,	—	277	13.0
Total animal food,	—	7817	1.5	Carrots,	—	29	4.0

* All weights, unless otherwise specified, are of the edible material free from bone, skin, etc.

† See pp. 126 and 127.

TABLE 33.—*(Continued.)*

FOOD MATERIALS.	Ref. No.*	Weight.	
		Lbs.	Oz.
FOOD PURCHASED.			
Vegetable Food (Con.)			
Celery,	—	92	—
Onions,	—	206	13.0
Potatoes,	—	333	9.5
Squash,	—	229	8.0
Sweet potatoes,	—	519	9.5
Turnips,	—	302	—
Peaches, dried,	—	49	8.0
Prunes, dried,	—	68	12.0
Total veg. food,	—	**7896**	**14.5**
Total food,	—	**15714**	—
FOOD WASTED.			
Animal Food.			
Beef:			
Beef-tea meat,	—	147	4.5
Diet steak,	—	5	4.0
Hamburg steak,	—	22	4.0
Liver,	—	2	—
Roast,	—	47	14.0
Steak,	—	31	4.0
Corned,	—	99	3.0
Dried,	—	3	8.0
Corned-beef hash,	3	39	4.0
"Scramble,"	4	44	4.0
Soup,	5	99	12.0
Soup,	6	125	10.0
Pork: ham, smoked,	—	46	—
Fish, etc., as purchs'd:			
Cod, fresh,	—	83	—
Cod, salt, stewed,	8	50	—
Oysters,	—	13	10.5
Butter,	—	11	14.0
Cheese,	—	1	8.0
Total animal food,	—	**873**	**8.0**

FOOD MATERIALS.	Ref. No.*	Weight.	
		Lbs.	Oz.
FOOD WASTED.			
Vegetable Food.			
Corn meal mush,	15	57	8.0
Oatmeal mush,	16	49	10.0
Rice, boiled,	17	54	12.0
Bread, brown,	—	96	15.5
Bread, corn,	18	44	4.0
Bread, graham,	20	6	12.0
Bread, wheat,	21	386	14.0
Biscuit, soda,	24	17	8.0
Crackers, soda,	—	1	3.0
Cake, tea,	26	6	—
Cookies, molasses,	29	2	8.0
Cookies, sugar,	30	3	—
Doughnuts,	32	3	8.0
Griddle cakes,	33	10	4.0
Spaghetti,	25	104	12.0
Pie, apple,	—	38	4.0
Pudding, bread,	36	62	4.0
Pudding, Indian meal,	38	80	8.0
Pudding, rice,	40	51	12.0
Pudding, tapioca,	42	62	8.0
Fish dressing,	44	9	12.0
Beans, cooked,	—	122	—
Cabbage,	—	32	8.0
Celery,	—	66	—
Onions,	—	35	—
Squash,	—	51	4.0
Sweet potatoes,	—	37	12.0
Turnips,	—	26	4.0
Peach sauce,	47	32	12.0
Prune sauce,	48	36	—
Wet waste,	50	94	—
Total veg. food,	—	**1683**	**14.5**
Total food,	—	**2557**	**6.5**

* See pp. 126 and 127.

TABLE 34.

Weights and percentages of food materials and nutritive ingredients used in dietary study No. 254.

[*Quantities per person per day.*]

FOOD MATERIALS.	WEIGHTS.					PERCENTAGES OF TOTAL FOOD.				
		NUTRIENTS.					NUTRIENTS.			
	Food materials.	Protein.	Fat.	Carbohydrates.	Fuel value.	Food materials.	Protein.	Fat.	Carbohydrates.	Fuel value.
FOOD PURCHASED.	Gm.	Gm.	Gm.	Gm.	Cal.	%	%	%	%	%
Animal Food.										
Beef, veal, mutton,	148	25	35	—	—	9.4	24.3	26.0	—	—
Pork, lard, etc.,	34	5	15	—	—	2.2	4.7	11.6	—	—
Fish,	45	5	—	1	—	2.9	4.6	.2	.2	—
Eggs,	22	3	2	—	—	1.4	15.1	1.6	—	—
Butter,	46	—	39	—	—	2.9	.4	29.5	—	—
Cheese,	6	2	2	—	—	.4	1.4	1.5	—	—
Milk,	479	16	19	24	—	30.5	2.8	14.5	6.1	—
Total animal food,	**780**	**56**	**112**	**25**	**1375**	**49.7**	**53.3**	**84.9**	**6.3**	**42.1**
Vegetable Food.										
Cereals,	489	39	19	257	—	31.2	37.4	14.2	65.6	—
Sugars and starches,	62	—	—	58	—	3.9	—	—	14.6	—
Vegetables,	225	9	1	45	—	14.4	8.9	.9	11.4	—
Fruits,	12	—	—	8	—	.8	.4	—	2.1	—
Total veg. food,	**788**	**48**	**20**	**368**	**1890**	**50.3**	**46.7**	**15.1**	**93.7**	**57.9**
Total food,	**1568**	**104**	**132**	**393**	**3265**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
FOOD WASTED.										
Animal,	—	10	12	4	170	—	9.9	8.8	1.0	5.2
Vegetable,	—	10	4	55	305	—	9.3	3.0	13.9	9.3
Total,	—	**20**	**16**	**59**	**475**	—	**19.2**	**11.8**	**14.9**	**14.5**
FOOD ACTUALLY EATEN.										
Animal,	—	46	100	21	1205	—	43.4	76.1	5.3	36.9
Vegetable,	—	38	16	313	1585	—	37.4	12.1	79.8	48.6
Total,	—	**84**	**116**	**334**	**2790**	—	**80.8**	**88.2**	**85.1**	**85.5**

TUBERCULOUS COWS, AND THE USE OF THEIR MILK IN FEEDING CALVES.

By C. S. Phelps.

In October, 1896, the Station made arrangements with the State Cattle Commissioners by which four condemned Devon cows were taken for experiment. The herd from which these animals came was first tested with tuberculin in March, 1896, but these particular animals failed to respond. In October, 1896, the herd was again tested with tuberculin, and the four cows, which failed to respond in the earlier test, responded, and were shortly after taken to the Station. These tests were made under the supervision of the State Cattle Commissioners.

The following table gives the temperatures in the two tests made before the cows were taken for experiment. The official numbers for the cows used in these tests have been retained by the Station.

TABLE 35.

*Tuberculin tests made with cows prior to their arrival at the Station.**

Number of Cow.	Before Injection.		After Injection.				
	8 P. M.	10 P. M.	6 A. M.	8 A. M.	10 A. M.	12 M.	2 P. M.
Test made March 14–15, 1896.							
1337, - - - -	102.2	102.8	102.3	102.6	103.0	102.4	102.4
1341, - - - -	101.1	101.3	101.6	102.2	102.2	102.4	102.0
1343, - - - -	101.0	101.6	101.8	101.8	102.1	102.1	102.2
1344, - - - -	101.0	101.5	100.7	101.6	101.4	102.0	101.4
Test made October 26–27, 1896.							
1337, - - - -	101.3	101.4	100.6	101.6	103.0	104.4	104.8
1341, - - - -	101.6	101.4	100.8	101.7	102.4	104.4	105.6
1343, - - - -	102.0	101.7	99.6	101.6	102.8	104.4	105.0
1344, - - - -	101.8	101.1	102.0	102.0	105.0	105.8	105.6

* Through the courtesy of the former Secretary of the State Cattle Commission we are able to publish the temperatures obtained in the tuberculin tests made prior to the arrival of the cows at the Station. These tests were made by Dr. L. J. Storrs.

Care of the cows, and tuberculin tests after they were taken in charge by the Station.—When the cows were brought to the Station they were placed in a high, light, and airy stable, affording about 1,500 cubic feet of air space per cow, although later several calves occupied the same stables with the cows. The Station barn is located about eighty rods from the College barn, and the tuberculous animals have been kept separate from any other cattle. Adjoining the stable is a yard about one-half acre in area, where the animals can exercise. In mild weather they have occupied the yard most of the day. No special treatment for the disease has been attempted, but good care and feed have been afforded at all times. Plans were made whereby the animals could be subjected to the tuberculin test from time to time. These tests were, in most cases, made by the College veterinarian.

The four cows have been under the care and observation of the Station for three and one-half years at the time this report closes (May, 1900). Accounts of the general health of the animals, and the results of tests on the use of their milk in feeding both their own offspring and calves from healthy cows, have been given in the last two reports of the Station. Up to September, 1897, these tests were made by Dr. George A. Waterman. The test in September, 1897, was made by Dr. L. J. Storrs, as the College was temporarily without a veterinarian. Beginning with December, 1897, the tuberculin tests, and three physical examinations, have been made by Dr. N. S. Mayo. Since that time the tuberculin tests of the cows have been made less frequently than for the first year that the animals were at the Station. In the tests made by Dr. Waterman only two temperatures were taken before the tuberculin was injected, while in the tests made by Dr. Mayo temperatures were taken every two or three hours for a period of twelve to fifteen hours before injection. In the tables only the maximum and the average temperatures before injection are given. A rise of two or more degrees above the maximum temperature before injection, occurring within twenty-four hours after injection, is considered a response to the tests. The tuberculin tests made since January 1, 1897, are shown in the following table. The temperatures which indicate a response to the test are printed in bold-faced type.

TABLE 36.

Tuberculin tests of tuberculous cows, and of calves which were fed their milk.

DATE OF TEST, NUMBER AND AGE OF ANIMAL.	BEFORE INJECTION.*		AFTER INJECTION.							
			6 A.M.	8 A.M.	10 A.M.	12 M.	2 P.M.	4 P.M.	6 P.M.	8 P.M.
Jan. 26–27, 1897.	5 P.M.	9 P.M.								
1337, 4 yrs., - -	101.0	101.2	101.5	102.1	**104.0**	**105.2**	**106.1**	—	**104.8**	—
1341, 6 yrs., - -	102.2	101.5	102.1	102.5	103.6	102.6	103.2	**104.9**	**106.1**	—
1343, 6 yrs., - -	100.9	100.3	101.4	102.0	102.9	**105.1**	**106.2**	—	**105.0**	—
1344, 6½ yrs., -	100.6	100.1	101.2	101.6	103.0	**105.0**	**105.9**	—	**105.6**	—
A (calf), 1 mo., -	102.0	102.0	101.5	101.1	101.4	101.6	101.6	—	102.2	—
Mar. 3–4.	4 P.M.	9 P.M.								
B (calf), ½ mo., -	102.7	103.4	102.1	102.6	102.2	101.5	101.7	—	—	—
Mar. 29–30.	5 P.M.	9 P.M.								
A (calf), 3 mos., -	102.4	102.6	102.4	102.0	101.7	101.9	102.4	—	—	—
April 26–27.	5 P.M.	9 P.M.								
1337, 4½ yrs., -	103.7	102.0	102.4	102.2	102.0	102.2	102.0	—	—	—
1341, 6½ yrs., -	102.8	101.5	102.6	103.7	**105.2**	**106.0**	**105.8**	—	—	—
1343, 6½ yrs., -	102.0	101.6	102.0	102.0	102.2	102.0	101.8	—	—	—
1344, 7 yrs., - -	101.6	101.0	102.5	103.4	**103.8**	**103.8**	102.8	—	—	—
July 30–31.	5 P.M.	11 P.M.								
1337, 4½ yrs., -	101.8	101.3	102.2	102.0	102.2	102.1	102.2	101.3	102.4	102.1
1341, 6½ yrs., -	101.6	101.0	102.5	102.8	101.9	101.8	101.5	101.2	101.3	101.0
1343, 6½ yrs., -	101.8	101.0	102.8	102.7	102.1	102.2	102.0	101.8	101.4	101.4
1344, 7 yrs., - -	101.1	100.6	102.1	102.4	101.7	102.0	102.0	102.0	102.0	101.0
A (calf), 7 mos., -	102.5	101.8	101.8	101.8	101.4	102.0	101.8	—	—	—
B (calf), 5 mos., -	101.8	101.9	101.2	101.4	101.6	101.6	101.9	—	—	—
C (calf), 3 mos., -	103.0	102.0	101.8	101.5	101.7	101.8	102.4	—	—	—
Sept. 27–28.	8 P.M.	10 P.M.								
1337, 5 yrs., - -	—	101.8	102.0	102.1	101.9	101.6	101.6	—	—	—
1341, 7 yrs., - -	—	101.5	101.3	101.2	101.5	102.0	101.8	—	—	—
1343, 7 yrs., - -	—	101.7	101.5	101.6	101.5	101.3	101.5	—	—	—
1344, 7½ yrs., -	—	101.0	101.1	101.4	101.2	101.2	101.1	—	—	—
A (calf), 9 mos., -	102.6	101.6	101.6	101.4	101.7	101.8	102.0	—	—	—
B (calf), 7 mos., -	102.3	101.7	101.7	101.3	101.0	101.2	101.5	—	—	—
C (calf), 6 mos., -	102.4	101.6	101.8	101.4	101.7	101.8	101.8	—	—	—
Dec. 17–18.	Maximum.	Average.†								
1337, 5 yrs., - -	102.8	101.6	101.3	101.7	102.9	102.9	102.6	102.5	103.0	103.5
1341, 7 yrs., - -	102.2	101.3	101.2	102.0	102.3	103.0	102.2	102.6	102.1	101.5
1343, 7 yrs., - -	102.2	101.5	101.1	102.0	101.9	102.4	102.0	101.8	101.0	101.8
1344, 7½ yrs., -	102.3	101.0	101.5	102.2	**104.4**	**106.4**	**107.0**	**105.7**	**104.4**	102.8
A (calf), 1 yr., -	101.8	101.1	100.8	101.8	101.6	101.6	100.9	102.2	101.8	101.0
B (calf), 10 mos., -	101.8	101.3	101.0	101.2	101.0	101.2	101.9	101.7	102.2	100.8
C (calf), 9 mos., -	102.2	101.4	101.0	101.5	101.2	101.4	101.7	101.7	102.2	101.4
D (calf), 1 mo., -	102.6	102.1	102.0	101.7	101.2	102.0	101.8	102.0	102.0	102.0

* The tuberculin was injected between 9 and 11 P. M. of the first day.

† Average of temperature taken once in two or once in three hours for 12 to 15 hours before injection.

TABLE 36.—*(Continued.)*

DATE OF TEST, NUMBER AND AGE OF ANIMAL.	BEFORE INJECTION.*		AFTER INJECTION.							
			6 A.M.	8 A.M.	10 A.M.	12 M.	2 P.M.	4 P.M.	6 P.M.	8 P.M.
April 11–12, 1898.	Maximum.	Average.†								
1337, 5½ yrs., -	101.8	101.3	101.8	102.6	102.3	102.2	101.8	101.8	101.9	102.0
1341, 7½ yrs., -	101.8	101.3	102.0	102.6	102.4	102.6	101.9	102.0	101.8	101.6
1343, 7½ yrs., -	102.1	101.5	102.3	**104.0**	**104.2**	**104.5**	**104.0**	102.5	101.9	102.0
1344, 8 yrs., -	101.2	100.8	101.7	102.5	102.7	102.8	102.7	103.0	103.2	103.0
A, 16 mos., - -	102.2	101.4	101.6	101.8	101.6	102.0	101.8	101.3	102.0	102.0
B, 14 mos., - -	101.9	100.9	100.5	101.0	100.6	100.6	100.8	100.5	101.4	101.4
D, 4 mos., - -	102.3	101.8	102.3	101.8	101.7	101.7	102.0	102.7	102.6	102.6
Dec. 22–23.										
1337, 6 yrs., -	103.0	101.9	101.2	102.2	102.9	102.0	101.9	101.3	101.3	—
1341, 8 yrs., - -	103.0	101.7	102.6	103.8	103.9	100.0	100.8	102.1	101.9	—
1343, 8 yrs., - -	103.0	102.1	104.2	103.8	103.8	101.5	102.1	102.3	101.7	—
1344, 8½ yrs., -	102.4	101.4	101.6	102.0	102.4	101.4	100.8	101.1	101.3	—
A, 2 yrs., - -	102.5	101.5	101.4	101.7	102.2	102.6	103.1	102.5	102.5	—
B, 22 mos., - -	102.2	101.7	**104.4**	**106.2**	**106.3**	**104.9**	**106.0**	**105.3**	**105.0**	—
C, 21 mos., - -	102.2	100.6	102.1	102.3	101.4	101.6	102.9	101.6	—	—
D, 13 mos., - -	102.2	101.9	101.6	102.2	101.8	102.0	101.7	101.9	101.9	—
E, 4 mos., - -	102.8	102.0	101.5	101.7	101.4	102.1	101.7	101.8	101.6	—
F, 4 mos., - -	103.3	102.1	102.0	102.0	101.6	102.5	101.6	101.6	102.7	—
G, 4 mos., - -	103.0	102.6	101.4	101.8	100.8	102.2	103.1	102.9	102.2	—
H, 3 mos., - -	102.4	102.0	102.6	101.4	101.5	101.2	101.4	101.4	101.8	—
April 11–12, 1899.										
A, 2⅓ yrs., - -	102.4	101.9	102.0	101.4	100.8	100.4	101.9	101.3	—	—
June 2–3.										
1337, 6½ yrs., -	102.2	101.4	101.1	101.8	102.3	102.0	101.7	102.1	—	—
1341, 8½ yrs., -	103.0	102.0	101.2	100.8	102.8	102.6	102.8	102.0	—	—
1343, 8½ yrs., -	101.8	101.4	**105.4**	**104.7**	**103.7**	**104.7**	103.5	100.5	—	—
1344, 9 yrs., - -	102.0	101.4	102.2	101.7	102.5	102.8	103.1	103.0	—	—
D, 18 mos., - -	102.1	101.8	101.7	100.8	100.4	101.2	101.5	101.7	—	—
E, 10 mos., - -	103.0	101.8	101.3	101.2	101.7	101.2	101.5	101.5	—	—
F, 10 mos., - -	103.2	101.9	101.5	101.4	101.6	101.8	102.2	102.6	—	—
G, 9 mos., - -	102.8	102.2	101.2	101.7	101.2	101.5	101.2	101.7	—	—
H, 9 mos., - -	105.9	105.1	103.4	103.6	104.5	104.7	105.4	105.4	—	—
I, 3 mos., - -	102.6	102.0	101.4	102.8	103.6	103.8	104.5	**104.6**	—	—
Dec. 1–2.										
1337, 7 yrs., - -	100.6	100.4	101.2	101.4	102.2	102.4	102.6	101.8	101.6	—
1341, 9 yrs., - -	103.8	102.4	104.0	103.4	102.8	**106.2**	101.8	102.0	102.7	—
1343, 9 yrs., - -	103.8	102.8	105.6	105.6	105.4	104.8	103.6	103.0	103.4	—
1344, 9½ yrs., -	102.0	100.9	102.4	102.2	102.4	103.2	100.0	100.0	103.0	—
E, 16 mos., - -	102.9	102.2	103.2	104.4	104.8	**106.1**	**106.0**	**105.2**	**105.2**	—
F, 16 mos., - -	103.0	102.2	102.2	102.4	101.6	101.6	102.0	101.0	101.4	—
G, 15 mos., - -	103.2	102.8	104.2	**105.4**	**106.0**	**105.2**	105.0	103.8	103.8	—
H, 15 mos., - -	102.2	101.5	103.0	103.8	**107.2**	**106.0**	**105.4**	**105.4**	**104.8**	—
I, 9 mos., - -	102.0	101.8	102.6	103.2	103.4	**104.0**	**104.2**	**104.2**	103.0	—

* The tuberculin was injected between 9 and 11 P. M. of the first day.

† Average of temperature taken once in two or once in three hours for 12 to 15 hours before injection.

TABLE 36.—*(Continued.)*

DATE OF TEST, NUMBER AND AGE OF ANIMAL.	BEFORE INJECTION.*		AFTER INJECTION.						
			6 A.M.	8 A.M.	10 A.M.	12 M.	2 P.M.	4 P.M.	6 P.M.
Mar. 19–20, 1900.	Maximum.	Average.†							
1337, 7½ yrs., -	101.7	101.3	101.6	101.2	101.6	102.2	102.3	100.8	101.2
1341, 9½ yrs., -	102.6	101.8	102.9	103.9	103.8	104.2	100.4	100.9	102.3
1343, 9½ yrs., -	102.1	101.2	102.1	101.6	103.7	103.5	101.8	102.0	102.1
1344, 10 yrs., -	101.8	100.6	101.2	101.7	101.9	101.9	102.0	102.0	101.7
F, 19 mos., - -	102.2	101.4	102.1	102.6	**104.3**	**105.2**	103.7	**104.8**	**105.3**
H, 18 mos.. - -	102.3	101.6	103.0	103.2	103.4	104.0	102.2	101.8	102.7
K, 3 mos., - -	102.5	102.2	104.2	105.0	**106.2**	**107.2**	**106.3**	**106.7**	**106.3**

* The tuberculin was injected between 9 and 11 P. M. of the first day.

† Average of temperature taken once in two or once in three hours for 12 to 15 hours before injection.

HISTORY AND PHYSICAL CONDITION OF THE COWS FROM FEBRUARY, 1899, TO MAY, 1900.

Cow No. 1337.—This cow was in good condition of flesh during the late winter and throughout the spring of 1899. She continued to suckle her calf (H), which had been dropped September 15, 1898, throughout the spring and summer of 1899. The cow had a smooth, sleek coat, seemed bright and active, and showed no tendency to cough. The calf was prevented from sucking its dam after reaching the age of one year, September 15, 1899. At this time the cow was beginning to show indications of drying off preparatory to calving, and milking her was discontinued the latter part of September. This cow produced a vigorous calf, December 2, 1899, which appeared to be full sized and well developed. The calf was attacked by scours soon after birth, and died December 4. The cow continued in a vigorous condition of health throughout the winter, having a sleek coat, remaining in a good state of flesh, and producing from 16 to 20 pounds of milk per day. In May, 1900, she appeared active and vigorous, with the exception of a slight cough which developed during the latter part of the winter or in the early spring. Cow No. 1337 was subjected to the tuberculin test, June 2–3, and December 1–2, 1899, and March 19–20, 1900, but did not respond to any of the tests. This cow has not responded since January, 1897, a period of three and one-third years.

Cow No. 1341.—This cow remained in a fair condition of flesh during the late winter and throughout the spring of 1899. She continued to give a good flow of milk until the latter part of July of that year. At that time the animal was attacked by scours, showed loss of appetite, and began to decline in flesh quite rapidly. She was isolated from the rest of the herd in a small open shed, and after about a week ceased to give milk entirely for seven or eight days. Soon after this her appetite began to improve and she ate dry fodders quite freely. Milking was then resumed, and the milk flow increased greatly in quantity for the next three weeks. This cow improved somewhat in condition of flesh during August and September, 1899, and remained in a fair state of health throughout the fall and early winter. She was dried off, preparatory to calving, late in December. This cow has had a somewhat irregular tendency to a looseness of the bowels, but showed no further signs of scours during the fall of 1899. Up to this time she had not coughed noticeably since coming to the Station in November, 1896. Cow No. 1341 was dry from late in December, 1899, till February 11, 1900, at which time she dropped a vigorous calf. The calf appeared fully developed, but it was attacked by scours a few days after birth and died February 15. After calving the cow was rather thin in flesh, although she gave a good flow of milk, during March producing from 25 to 30 pounds per day. During the spring of 1900 this cow seemed thin in flesh, had a rough coat, a dull, sunken eye, and was rather hollow and sunken at the flanks. She has coughed considerably throughout the winter and spring, and if exercised vigorously will cough severely. This cow is evidently "running down," although she gives a good flow of milk at the present time (May, 1900). Cow No. 1341 was tested with tuberculin June 2–3, 1899, but did not respond, and again December 1–2, 1899, when she responded. March 19–20, 1900, she was tested again, but did not respond.

Cow No. 1343.—This cow remained in a good state of flesh during the late winter and throughout the spring of 1899. She has always shown a beefy tendency, appearing rather fat. During the latter part of the winter of 1898 and 1899 she did not appear as fleshy as formerly, but yet was in good order. She continued to produce a fair flow of milk during the summer and early fall of 1899, and remained in a fair state of

flesh, although not as fat as during the summer of 1898. Up to the fall of 1899 she had shown more of a tendency to cough than any of the other cows. This was especially noticeable after feeding dry feeds or when the animal was made to exercise violently. This cow went dry about the middle of November, and calved December 23, 1899, producing a strong, vigorous heifer calf. The calf had a mild attack of scours a few days after birth, but recovered within a short time. The cow lost flesh quite rapidly after calving, although she has continued to produce a good flow of milk. She gave from 16 to 22 pounds of milk for the first three months after calving. At the present time (May, 1900,) she is rather thin, her ribs protruding quite plainly. Cow No. 1343 coughs more than any of the other cows, and her coughing has increased in frequency during the past six months. This cow was tested with tuberculin June 2–3, 1899, and responded to the test. She was again tested December 1–2, 1899, and March 19–20, 1900, at which times she gave no response.

Cow No. 1344.—This cow remained farrow, after coming to the Station in the fall of 1896, until the fall of 1899. During this time she continued to produce a good flow of milk. In April and May, 1899, she was giving from 8 to 11 pounds per day. During the spring and summer of 1899 she was in a fair state of flesh and appeared to be quite vigorous in health. She was dried off, preparatory to calving, about September 1, 1899. This cow manifested a lameness in the stifle joint of the right rear leg some time during the summer of 1899, and although she became somewhat lame it seemed to give her comparatively little trouble. This cow dropped a bull calf October 15, 1899. The calf appeared rather weak at birth and refused to suckle its dam, and was probably premature by about a month. The calf died October 22, 1899. The cow began to produce a liberal flow of milk shortly after calving, and during the latter half of November was giving from 25 to 30 pounds per day. She kept up a good flow of milk throughout the winter, producing from 18 to 20 pounds per day near the end of March, 1900. Previous to the winter of 1899 and 1900 this cow had been in a fair state of flesh, with a tendency to remain rather fat, although during the summer of 1899 she was not as fleshy as in 1898. During the past six months she has lost

flesh, and at the present time (May, 1900,) seems quite thin and shows the position of her ribs plainly. Previous to the fall of 1899, cow No. 1344 was not noticed to have any cough, but during the past winter she has coughed quite vigorously. The lame leg has been quite badly swollen about the stifle joint, and this lameness has caused her considerable inconvenience in moving about. She was, however, less lame after warm weather came, and she was able to exercise freely in the yard. This cow was tested with tuberculin June 2–3, and December 1–2, 1899, and again March 19–20, 1900, but did not respond to any of these tests.

PHYSICAL EXAMINATIONS.

On May 8, 1898, and February 7, 1899, Prof. N. S. Mayo, the College Veterinarian, made physical examinations of the animals. The report of these examinations were given in the article on the subject in the Report of the Station for 1898. They are repeated here for comparison with the report of the examination made by the same veterinarian, May 26, 1900. These reports are as follows:

Report of the Veterinarian, May 8, 1898.—It is a fact well recognized that bovine tuberculosis, unless well advanced, is one of the most difficult diseases to diagnose upon a physical examination.

Of the seven animals examined four are the Devon cows that have been tested and found to respond at one time or another, three (A, B, and D) are young bulls that have been fed with the milk of the cows. The calves have not reacted to the tuberculin test, and a careful physical examination fails to reveal any indications that they have tuberculosis.

Of the four cows that have responded to the test, No. 1337 presents no symptoms of tuberculosis. She is in good flesh and looks well. Her temperature was 102.2° F., respirations full and at the rate of twelve per minute.

Cow No. 1341 is thinner in flesh than any of the others, and seems to be affected with a slight but chronic looseness of the bowels. Her temperature was 102° F., and respirations twelve per minute.

Cow No. 1343 is rather fat. She is troubled with a chronic cough, and auscultation indicates that the anterior (cephalic) lobes of the lungs, especially the right, are tuberculous. Her temperature was 102.6° F., and respirations are twenty-two per minute. Cows Nos. 1337, 1341, and 1343 are pregnant.

Cow No. 1344 is in good flesh. Temperature 101.8° F., and respirations fifteen per minute. Nothing abnormal could be detected upon a physical examination. No enlarged glands could be detected in any of the animals examined. Of the four cows that have at some time responded to the test, Nos. 1337 and 1344 show no symptoms of the disease having developed. In No. 1341 the chronic looseness of the bowels may be considered as a suspicious symptom of a tubercular affection of the digestive tract. In No. 1343 the physical symptoms indicate tuberculosis of the lungs.

It must be remembered that all of these animals have had good care and attention, and have not been exposed to conditions or circumstances that would cause the disease to develop.

Report of the Veterinarian, February 7, 1899.—Of the four Devon cows examined, No. 1337 does not seem to be in as thrifty condition as she ought to be, considering her care and feed. No. 1341 is not in as thrifty condition as No. 1337, and would probably be condemned as tuberculous on a physical examination. Nos. 1343 and 1344 are in excellent condition, physically, both being rather fat, and are looking well. The only evidence of disease is found in No. 1343, her respirations not being as full and deep as they should be normally. No cough was noted in any of the animals.

Report of the Veterinarian, May 26, 1900.—Cow No. 1337. In excellent physical condition as far as could be determined; good flesh, coat smooth and of good color, respirations sixteen per minute. I was unable to detect any abnormal sounds or absence of sounds in the lungs upon auscultation. This cow is evidently well along in pregnancy.

Cow No. 1341. Thin in flesh and does not look in a thrifty condition. Coat is rough and has not shed well. A part of her physical condition may be attributed to her having been in milk for some time. This cow's lungs appear to be slightly affected. Respirations, twenty-two per minute.

Cow No. 1343. Rather thin in flesh. Coat looks some better than No. 1341, but No. 1343 coughs quite badly, and auscultation reveals considerable areas of solidification in both lungs. Respirations, thirty-six per minute.

Cow No. 1344. Very thin in flesh, and her general physical condition is not good. She is suffering from severe lameness in the right hind leg, which appears to be due to a tubercular affection of the stifle joint. A considerable portion of this cow's poor condition must be attributed to her lameness. Respirations, twenty per minute.

N. S. Mayo, D. V. S., *College Veterinarian.*

FEEDING CALVES WITH THE MILK OF TUBERCULOUS COWS.

A large part of the time during the past three and one-half years the milk of the four tuberculous cows has been fed to calves. In some instances the milk has been fed until the calf was a year or more in age. In a few cases the calves were allowed to suckle their dams, while in others they were fed the milk from pails. In most of these experiments the calves have been kept in the same stable with the cows, and, of course, there was considerable likeliness that the disease might be contracted from other sources than the milk. One object of the experiment was to test the relative danger in keeping calves associated with the cows. In some later experiments calves are being fed the milk of these cows while being quaranteened from them.

During the first two years that the cows were at the Station four calves were kept in the stable with them a large part of the time, and were fed the milk of the diseased cows, but in no case did the calves show any sign of the disease as far as could be detected by the tuberculin test or by physical symptoms. The following is a brief history of the feeding tests which have been made during the three and one-half years that the cows have been at the Station.

Feeding Calf A with the milk of Cows 1344 and 1341.—This calf was dropped December 25, 1896, by a vigorous grade cow in the college herd. The calf was fed the milk of cow No. 1344 from January 7 to March 28, 1897. It was tested with tuberculin January 26–27, and again March 29–30, 1897, but gave no response to either of the tests. At that time the supply of milk from cow No. 1344 was less than the calf seemed to need, and it was fed the milk of cow No. 1341. Calf A was fed the milk of this cow from April 1, 1897, to July 9, 1898. In May, when about a year and a half old, it was castrated, and was sent to pasture early in July following. At the time this steer went to pasture it was a vigorous animal weighing about 500 pounds. Early in November steer A was returned to the same stable with the tuberculous cows, and during the following winter was fed a suitable ration for fattening. The animal was sold for beef in April, 1899. Tuberculin tests of this animal were made January 26–27, March 29–30, July 30–31, September 27–28, December 17–18, 1897, and April 11–12, and December 22–23, 1898, and again just before being sold for beef, April 11–12, 1899. From this record it may be seen that this animal was fed the milk of two of the tuberculous cows for about a year and a half, was then at pasture for about four months, then it was again kept in the same stall with the tuberculous cows for another period of five months. The animal remained healthy, as far as was indicated by the tuberculin test or by physical examination, up to the time of slaughter, when nearly two years and four months old.

Feeding Calf B with the milk of Cow 1343.—This calf was dropped by a vigorous Jersey cow in the college herd, February 20, 1897, and was ten days old when the feeding period began. When about two weeks old it was tested with tuberculin, and gave no response. From March 1, 1897, to early

in July, 1898, calf B was fed the milk of cow No. 1343. This calf was not a vigorous eater, and at times refused single feeds of milk. The calf seemed healthy, and ate hay readily. When a year old the animal was thought to be rather small for its age, but this may have been due to the fact that it had always refused grain feeds. This animal was castrated in May, 1898, and was sent to pasture with steer A in the early part of July. It was returned to the same stable with the cows early in November, and started upon a heavy grain ration with a view to fattening for beef. December 22–23, this steer gave a marked response to the tuberculin test (see temperature, Table 36, page 153). In addition to the marked rise in temperature, the steer showed physical symptoms by a roughness of the coat, shivering, and twitching of the muscles. Steer B was killed and carefully examined by the College Veterinarian, Dr. Mayo, December 30, 1898. The only trace of the disease found was a few small tubercles in one of the pharyngeal glands of the throat. The disease was, with little doubt, of recent origin. While, of course, there is no proof as to how this animal contracted the disease, it seems quite probable that the germs may have entered the system in the breath after the animal was returned to the stable early in November, 1898.

Feeding Calf C with the milk of Cow 1337.—This was a heifer calf, dropped by cow No. 1337, April 5, 1897. The calf was allowed to suckle its dam until about six months old. About October 1 the calf was weaned, but was fed the milk of its dam until January, 1898. It was then gradually put upon a skim-milk diet, and was placed in the college herd with the intention of raising the calf for dairy purposes. The animal was tested with tuberculin July 30–31, September 27–28, and December 17–18, 1897, and again December 22–23, 1898. The heifer produced her first calf December 5, 1899, and has continued to give a fair flow of milk. She was tested with tuberculin June 2–3 and December 7–8, 1899, and April 25–26, 1900, but gave no response.

Feeding Calf D with the milk of Cow 1344.—This was a bull calf, dropped by a vigorous grade cow, November 29, 1897. It was fed the milk of cow No. 1344 from early in December, 1897, till February, 1899, after which it was given a grain and

hay ration entirely. From the time of birth until June, 1899, this animal was kept in the same stable and yard with the cows. It was then sold to a farmer living near the Station, who was informed of the history of the animal, and has been used since that time for breeding purposes. This animal (D) was tested with tuberculin December 17–18, 1897, and April 11–12, and December 22–23, 1898, and June 2–3, 1899, but in no case did it give any response to the test. When sold it it was a strong, vigorous animal, and seemed large for its age.

From these records it will be seen that the milk of the four cows was fed to four calves for periods varying from three months to a year and four months, and that in no case was there any sign of the disease during the feeding period. One animal (B) did respond to the tuberculin test nearly six months after the feeding period with the milk was ended, but from the mild form in which the disease then existed it would seem doubtful if the disease was contracted from the milk. These tests point to the conclusion that the milk of tuberculous cows, in the early stages of the disease, is not very likely to transmit the disease when fed to healthy calves.

As will be seen from the records of the history and conditions of the animals, cows Nos. 1337, 1341, and 1343 produced calves in August and September, 1898. It was decided to feed several of these calves upon the milk of their dams. These feeding tests were continued for about a year.

Feeding Calves E and F with the milk of Cow 1341.—Calf E was a large heifer calf dropped by cow No. 1341, August 11, 1898; and calf F was a bull calf dropped by a grade cow in the college herd about the same date. The dam of calf F was supposed to be healthy, but three months after the birth of the calf the cow developed a severe case of tuberculosis.* The

* This cow was tested with tuberculin December 30-31, 1897, but gave no response to the test. She calved August 27, 1898, and appeared in a healthy, vigorous condition until the herd was placed in winter quarters early in November. Soon after, she began to refuse silage, and dropped off rapidly in milk flow, but manifested no serious symptoms until about ten days after she began to refuse silage. At that time the cow began to scour badly, and was placed in a box stall away from the rest of the herd. For the next ten days she ran down in flesh rapidly, so that it was thought wise to destroy her. A post-mortem examination showed a severe case of tuberculosis, the tubercular lesions being present in the liver, the spleen, and the lungs. Some of the lesions were encysted in such a way as to indicate that the disease was one of long standing, and it is probable that the tuberculin test which was made eleven months previous to the time of killing the cow failed to cause a response, owing to the advanced condition of the disease, or the failure may have been due to a poor lot of tuberculin. The cow showed no outward appearance of the disease, and remained in good condition of flesh until she began to refuse her feed early in November, 1898.

calf appeared healthy and vigorous at birth, and continued so until more than a year and a half old. The plan of the test with these two calves was to pasteurize one-half of the milk of cow No. 1341 and feed it to its offspring, and to feed the balance of the milk in its normal condition to calf F. This calf was chosen for the purpose, because it was supposed that its dam was free from tuberculosis, as she did not respond to the tuberculin test made about seven months prior to the birth of the calf.

Both of these calves have been kept in a room separate from the tuberculous cows, although in the same barn with them. The calves were in the second story of the barn, while the cows were stabled in the basement underneath. The portion of the milk of cow No. 1341 which was fed to calf E was heated to a temperature of from 170° to 175° F., and diluted with cold water before feeding. The balance of the milk of the same cow, in a normal condition, was fed to calf F as soon as possible after milking. Both calves had a small quantity of bran added to the milk after they were about two months old. The feeding tests of these two calves continued from August, 1898, till June 5, 1899. Both calves were tested with tuberculin when about four months old, December 22–23, 1898, and again June 2–3, 1899, when nearly ten months old. In neither of these cases did they show any response to the test.

It was planned that the feeding tests of these two calves should continue for about two weeks longer, or until the animals could be sent to pasture; but by a misunderstanding on the part of the attendant the milk was not pasteurized for calf E, and both animals were fed the normal milk of cow No. 1341 from June 5 to 24, or for a period of nearly three weeks. Both calf E and calf F were brought from the pasture November 13, and were placed in the same stable with the tuberculous cows. They were again subjected to the tuberculin test December 1–2, 1899. Calf E (the offspring of cow No. 1341) responded to the test, giving a maximum temperature of 106°, while calf F showed no rise of temperature. Calf F was kept in the same stable with the cows until April, 1899, and in March, 1899, when nineteen months old, it also responded to the tuberculin test.

The history of these two calves and the peculiarity of the feeding tests are such as require more than passing notice. Calf F was the offspring of a cow which, within three months after birth of this calf, developed a severe case of tuberculosis. To the best of our knowledge also the dam of calf E was a pronounced case of tuberculosis. Dr. Mayo, in a report of the physical condition of the cows, February 7, 1899, says: "Cow No. 1341 . . . would probably be condemned as tuberculous on physical examination." Calf F was fed the normal milk of a tuberculous cow (No. 1341) for about ten months; was then at pasture for about five months, and was in the stable with the tuberculous cows for about four months more before it responded to the tuberculin test. Calf E was fed pasteurized milk from cow No. 1341 for nearly ten months, then normal milk from the same cow for about three weeks, then was at pasture nearly five months, and responded to the tuberculin test within three weeks of the time she was returned to the stable. The result of these tests seem to show that there were marked differences in the two calves in their power to resist the germs of tuberculosis. It would seem either that calf E must have contracted the disease within the three weeks in June, 1899, while it was being fed the normal milk of its dam, or else that the quarantine between the calves and the cows in the same barn was not effectual. On the other hand calf F, the offspring of another badly diseased cow, resisted the germs from the normal milk of cow No. 1341 for a period of over ten months, and also failed to contract the disease from association with the cows until a period of about a year had elapsed (omitting the time at pasture). The post-mortem examination of calf E was made by the College Veterinarian, February 12, 1900. The only trace of the disease discovered was in the liver, in which one tubercle, which was somewhat cheesy and about the size of a large walnut, was found in one of the smaller lobes. Calf F was sold in the Brighton market, under Government inspection, in April, 1900, and was passed as a slightly diseased animal.

Feeding Calf G with the milk of Cow 1343.—This was a small heifer calf, dropped by cow No. 1343, August 28, 1898. It was small at birth and appeared rather puny until a year or more old. It was fed the milk of its dam from the time of

birth until June 24, 1899, although it did not eat well and consumed only small quantities of the milk. This calf seemed to lack vigor, and remained thin in flesh until after it was sent to pasture late in June, 1899. This animal was at pasture with calves F and E from June 24 until November 13, 1899. It gave no response to tuberculin tests made December 22–23, 1898, and on June 2–3, 1899, but did respond to a test made December 1–2, about three weeks after the calf was returned to the stable from the pasture. The post-mortem examination made February 12, 1900, showed the following organs affected: left lung, cordal lobe, one tubercle about the size of a small walnut; in liver, several tuberculous bunches about the size of large peas; one lymphatic gland of the small intestines was tuberculous, being much enlarged, with the tissues broken down and curdy.

Feeding Calf H with the milk of Cow 1337.—This was a strong, vigorous heifer calf, dropped by cow No. 1337, September 15, 1898. This calf suckled its dam from the time of birth until one year old, September 15, 1899. At this time it was a large, vigorous animal, and appeared fat and healthy. Calf H was kept in the same stable and yard with the cows until about nineteen months old (April, 1900). It was first tested with tuberculin December 22–23, 1898, and again June 2–3, 1899, but did not respond to either of these tests. At the test made December 1–2, 1899, calf H gave a marked response. This animal was kept in the same stable with the cows throughout the winter of 1899 and 1900. It was sent to Brighton to be killed under Government inspection, in April, 1900, but was considered too badly diseased for the flesh to be used as food, and was ordered destroyed.

Feeding Calf I with the milk of Cow 1344.—Calf I was dropped March 24, 1899, by a tuberculous cow owned by the College which was temporarily being kept at the Station barn. During the feeding period which followed this calf was kept in the same stable with the tuberculous cows. This calf was fed the milk of cow No. 1344 from the time of birth till about the middle of July, 1898. When a little over two months old, June 1–2, it responded to the tuberculin test, and again December 2–3, 1899. From about the middle of July until October,

1899, this calf was fed the milk of cow No. 1343. In October it was weaned, and was fed a hay and grain ration until it was killed, February 12, 1900. Post-mortem examination showed one posterior mediastinal gland affected with encysted tubercular material. As far as could be found there was no active tuberculosis present in the system.

Feeding Calf K with the milk of Cow 1343.—Calf K was dropped by cow No. 1343, December 23, 1899. From birth till May 26, 1900, this calf was kept in the second story of the barn, above the cows, in a room closed from the rest of the barn. It was thought that the animal was under conditions of thorough quarantine from the other animals in the barn. It was fed the normal milk of its dam for nearly three months before being tested. Calf K was tested with tuberculin March 19–20, 1900, and gave a marked response.

In order to test the question as to whether the transmission of the disease has probably taken place through the milk or by association with the cows, some new feeding tests are being planned for the summer and fall of 1900. In these tests the calves will be kept at pasture, entirely separate from all other animals, and the milk of the tuberculous cows will be carried to them.

SUMMARY OF FEEDING TESTS.

Within the first two years that the tuberculous cows were under experiment one secondary case of tuberculosis developed. This case was discovered about twenty-five months after the cows came to the Station. During this time four animals, A, B, C, and D, were fed the milk of the cows in periods ranging from eighteen months to twelve months. Throughout the whole of this time, except the five months while steers A and B were at pasture, the young animals were closely associated with the cows. As has already been shown, there was good reason for the belief that the disease was present in its earlier stages when the cows came to the Station. The first two years' experience then would seem to show that when the disease exists in the cow in its earlier stages the chances for its transmission, either by the milk or by other means, to calves associated with the cows are quite limited.

The balance of the time that the cows have been at the Station, which includes the period from about two years to three and

one-half years after their arrival, entirely different results are recorded. During the period from August 15, 1898, to March 20, 1900 (nineteen months), five animals were fed the milk of the same lot of cows, and all five responded to one or more tuberculin tests made within that period, and proved to be diseased. Two cases developed within three months after birth, while the other three required from twelve to eighteen months for their development. The physical condition of the cows, for the past year, would seem to indicate that the disease has progressed decidedly in at least three of the four cows.

PRACTICAL DEDUCTIONS.

During the first two years it was practically impossible to detect any outward signs of tuberculosis in the cows, and careful physical examination by an expert only revealed a possible presence of the disease in one of the four animals, and a probable diseased condition in one other. During the past year and one-half, however, there have been noticeable outward signs of poor health, pointing towards a tubercular condition, and physical examination showed quite conclusive evidence of the disease in three of the four animals. The fact that no secondary case of the disease developed until the calves had been fed the milk of the cows from one to one and one-half years, and had been associated with the cows for about two years, would seem to show that there is little danger of the spread of the disease, where it exists in the earlier stages.

In the feeding tests for the first two years the young animals to which the milk was fed were kept, most of the time, in the same stable with the cows. Four calves were fed the milk of the tuberculous cows in periods ranging from nine months to eighteen months without showing any signs of the disease. The first case among the young animals was discovered about six months after the feeding of milk was discontinued.

In the second lot of feeding tests six calves were fed. Three of these were kept in a separate part of the barn from the cows, and three in the same stable. Two calves, one in the stable and one kept in another part of the barn, responded to the tuberculin test within three months after the feeding of the milk was begun. Of the other four, two responded soon after returning from the pasture where they had been for four months following a feeding

period of ten months. Two others were in the same stable with the cows for periods of from three to six months, after feeding tests of ten and twelve months were ended, before showing any indications of the disease. These tests would seem to show that as the disease in the cows becomes advanced the milk becomes more infectious, and that there is great danger to the health of other animals, both from the use of the milk and by association with the diseased animals.

The results of these experiments coincide with the general results of European observations, and indicate that the danger from the spread of tuberculosis through the milk of cows to other animals is not as great as has often been supposed. In the earlier stages of the disease, and at all times when the udder is not affected, the danger from the use of the milk thus appears to be quite limited. Great stress, however, should be laid on the danger of using as food for man or animals milk from cows which show any symptoms of udder affection, or when the disease is so far advanced in the cows as to be indicated by outward signs or other marked physical symptoms.

FIELD EXPERIMENTS WITH FERTILIZERS.

BY W. O. ATWATER AND C. S. PHELPS.

Owing in part to the fact that a large amount of other important work was pressing for publication, the field experiments of 1897 and 1898 have not yet been reported upon. In this article, therefore, an account is given of the field work of the Station for the past three* years. The experiments for the most part are in continuation of those carried out in preceding years and described in former reports of the Station. The field experiments have been mainly along the following lines:

1. Special nitrogen experiments on corn, cow peas, and soy beans, for the purpose of studying the effects of nitrogen in different quantities and combinations in the fertilizers upon the yields and the composition of the crops.

2. A rotation soil test on the Station land, for the purpose of studying the deficiencies of the soil and the needs of different crops for the different ingredients of fertilizers.

3. Experiments with grasses and other forage crops, mainly for the purpose of comparing the feeding values of different fodder crops, and of studying the effects of the nitrogen in the fertilizers upon the proportion and amount of protein in the different crops.

4. An experiment on soil improvement, for the purpose of comparing the relative economy of (1) stable manure, (2) a "complete" chemical fertilizer, and (3) green manures alone and in connection with mineral fertilizers for improving a soil apparently deficient in organic matter and in available nitrogen.

The results of the special nitrogen experiments and of the soil tests, during the past three* years, are here given. The results of the experiments with grasses and forage crops will

* In the case of soy beans the experiments of 1896 are also included.

be given in a later Report with those of future experiments. The experiment on soil improvement was begun during the past year, and is to be continued for several years. An account of the nature and plan of this work and the results of the preliminary experiment are given in the article following this one.

SPECIAL NITROGEN EXPERIMENTS.

The special nitrogen experiments of the past three years are an extension of a series which was begun in 1895 and continued in 1896, as described in the Reports of the Station for those years. The crops with which the experiments are made are corn, cow peas, and soy beans. These are grown on plots treated with fertilizers supplying nitrogen, phosphoric acid, and potash in different amounts and combinations, in the manner described in a later paragraph, the special purpose of the experiments being to study the effects of the nitrogen in the fertilizer upon the yields and the composition of the crops.

The special nitrogen experiments with these crops are carried out on a series of plots which, prior to 1895, had been used for similar experiments with mixed grasses. For the earlier experiments with grasses the experimental field was divided into ten long, narrow plots, each one-eighth acre in size. These were numbered and fertilized as shown in the diagram on page 170.

From this diagram it will be seen that two plots, Nos. 0 and 00, receive no fertilizer, while each of the other plots receives dissolved bone-black at the rate of 320 pounds, with 53 pounds of phosphoric acid, per acre, and muriate of potash at the rate of 160 pounds, with 82 pounds of potash, per acre. For convenience this mixture of superphosphate and potash salt is called "mixed minerals." Plots 7, 8, and 9 received, in addition to the mixed minerals, respectively 160, 320, and 480 pounds of nitrate of soda, with 25, 50, and 75 pounds of nitrogen, per acre, and are called the nitrate of soda group; while plots 10, 11, and 12 received, in addition to the mixed minerals, respectively 160, 320, and 480 pounds of sulphate of ammonia, with 25, 50, and 75 pounds of nitrogen, per acre, and are called the sulphate of ammonia group. The adjoining plots are separated from each other by narrow strips that are not fertilized.

Diagram illustrating the method of dividing the experimental field into plots, and the kinds and amounts of fertilizers used on each plot.

Each plot is 272¼ feet long by 20 feet wide. The unmanured strips separating the adjoining plots are 3 feet wide. The weights of the fertilizers are per acre.

EAST.

NORTH.

PLOT 0.	Nothing.		
PLOT 7.	Mixed minerals as Plot 6*a*, 480 lbs. Nitrate of Soda, - - 160 lbs.	Nitrogen,	- 25 lbs.
PLOT 8.	Mixed minerals as Plot 6*a*, 480 lbs. Nitrate of Soda, - - 320 lbs.	Nitrogen,	- 50 lbs.
PLOT 9.	Mixed minerals as Plot 6*a*, 480 lbs. Nitrate of Soda, - - 480 lbs.	Nitrogen,	- 75 lbs.
PLOT 6*a*.	Dissolved Bone-black, - 320 lbs. Muriate of Potash, - 160 lbs.	"Mixed minerals."	
PLOT 10.	Mixed minerals as Plot 6*a*, 480 lbs. Sulphate of Ammonia, 120 lbs.	Nitrogen,	- 25 lbs.
PLOT 11.	Mixed minerals as Plot 6*a*, 480 lbs. Sulphate of Ammonia, 240 lbs.	Nitrogen,	- 50 lbs.
PLOT 12.	Mixed minerals as Plot 6*a*, 480 lbs. Sulphate of Ammonia, 360 lbs.	Nitrogen,	- 75 lbs.
PLOT 00.	Nothing.		
PLOT 6*b*.	Mixed minerals as Plot 6*a*, 480 lbs.	Phosphoric acid, 53 lbs. Potash, - - 82 lbs.	

SOUTH.

WEST.

In the experiments with grasses previous to 1895, each of these plots was fertilized in the manner just described year after year, and the same crop—mixed grasses—was grown on all of them. In the experiments with corn, cow peas, and soy beans, which have been carried out on the same plots since

1895, the same arrangement of the plots and the same method of fertilizing them has been continued, namely those shown in the preceding diagram. But for the purpose of the later experiments the plots, which extend north and south, are subdivided by paths crossing them from east to west, so that each plot contains six subdivisions or sections, each one-fiftieth of an acre in size. The method of dividing the plots into sections is illustrated by the diagram on page 172, which shows also the crop grown on each section.

It is hardly to be expected that the effects of the fertilizers upon the yields of the crops can be determined as accurately from experiments made on plots of this size as from experiments made on larger plots. This is a matter, however, that is already quite generally understood, so that the results of these experiments in this respect are neither novel nor striking. The more important object of the experiments, and one with which farmers are not so familiar, is the study of the effects of the nitrogen of the fertilizers upon the proportion of nitrogen in the crop. It is believed that in this respect the results are quite as reliable from the experiments made on the small plots as could be obtained if larger plots were used. The particular advantage in the small plots is that a larger number of crops can be used for the experiments. Three different crops were grown on each plot, and the number might have been six.

The numbers of the plots in the diagram on page 172 are given at both ends of each plot. For convenience in referring to the sections they are designated by letters, A, B, C, etc., beginning with the section at the north end of each plot, and lettering to the south, as indicated for plots 0 and 6*b* in the diagram. A series of sections will include all the sections of the same letter. Thus, in discussing the experiments with corn, for instance, "Series A" will include all the sections at the north ends of the ten plots, and "Series F" will include all the sections at the south ends of the plots. It will be observed that each crop is grown on two sections of each plot; that is, upon two series of sections. In the accounts of some of the experiments the results from two series with the same crop are combined as if from a single series of sections twice the size of these; while in other experiments the results from each series are considered separately.

Diagram illustrating the method of dividing the plots into sections, and the kind of crop planted on each section.

The plots are fertilized exactly as shown in the preceding diagram. The plots are indicated by numbers, the sections by letters.

EAST.

	A	B	C	D	E	F	
0	Corn.	Soy beans.	Cow peas.	Cow peas.	Soy beans.	Corn.	0
7	Corn.	Soy beans.	Cow peas.	Cow peas.	Soy beans.	Corn.	7
8	Corn.	Soy beans.	Cow peas.	Cow peas.	Soy beans.	Corn.	8
9	Corn.	Soy beans.	Cow peas	Cow peas.	Soy beans.	Corn.	9
6*a*	Corn.	Soy beans	Cow peas.	Cow peas.	Soy beans.	Corn.	6*a*
10	Corn.	Soy beans.	Cow peas.	Cow peas.	Soy beans.	Corn.	10
11	Corn.	Soy beans.	Cow peas.	Cow peas.	Soy beans.	Corn.	11
12	Corn.	Soy beans.	Cow peas.	Cow peas.	Soy beans.	Corn.	12
00	Corn.	Soy beans.	Cow peas	Cow peas.	Soy beans.	Corn.	00
6*b*	Corn.	Soy beans.	Cow peas.	Cow peas.	Soy beans.	Corn.	6*b*
	A	B	C	D	E	F	

NORTH.

SOUTH.

WEST.

Explanation of tables.—Two tables, containing the data of the experiments, are given in the discussion of the results for each crop. The first table in each case shows the total weight of the crop taken from each section, the crops being weighed either at the time of harvesting or after drying in the field. In the experiments with corn and soy beans the total grain or seed from each plot was taken to the barn and allowed to dry before it was weighed. The corn stover was weighed after it had dried in the field. The cow pea fodder was weighed green as soon as possible after it was cut. The table shows also the estimated yields per acre for each crop as calculated from the size of the section and the weight of the crop taken from it, as well as the increase in the weight of the crop from the plots with the different fertilizers over the weight of the crop from the plots with no fertilizer. The costs of the fertilizers given in one column of the table are based upon the system of valuation adopted each year by the New England Experiment Stations, which varies slightly from year to year. For the years in which experiments reported in this article were made the valuations per pound of the different ingredients of fertilizers were as follows:

Assumed costs per pound.

	1896.	1897.	1898.	1899.
	Cents.	Cents.	Cents.	Cents.
Nitrogen (as nitrate of soda), - -	13½	14	14	12½
Nitrogen (as sulphate of ammonia), -	15	13½	14	15
Phosphoric acid (soluble*), - - -	5½	5½	4½	4½
Potash (as muriate), - - - -	4½	4½	4½	4½

The second table in each case shows the estimated total yields of the crop per acre, the percentage of water-free substance or dry matter in the crop when weighed, the percentage of protein (N. × 6.25) in the dry matter, and the calculated yields of dry matter and of protein. The total yield of dry matter per acre is found by multiplying the total weight of the crop by the percentage of dry matter in it; and the total yield of protein per acre is found by multiplying the yield of dry matter per

* A small proportion of the phosphoric acid was probably present in the form known as "reverted," but the valuation for this is only one-half cent less per pound than for the soluble.

acre by its percentage of protein. The last two columns of the table show the perçentage of the yields of dry matter and of protein from each plot if the average of the yields from the mineral plots be taken as a basis.

In making the analyses of the samples of these field crops tests for nitric acid were made in a considerable number of samples, especially those from the plots in which the largest quantities of nitrogen in nitric acid and other forms were applied in the fertilizers. The tests were made by treating cold water extracts with a sulphuric acid solution of di-phenylamin. The deep color of the extract interfered somewhat with the reactions and prevented quantitative determinations. But it was estimated that in no instance was the amount of nitric acid indicated sufficient to make one per cent. of the total nitrogen found in the samples.

In 1897 the experiments were vitiated by excessive rains during the growing season. The nitrogenous fertilizers failed to produce results in amount and uniformity of yield such as had been obtained in other years. This may have been due to a loss of the materials in which the nitrogen was supplied to the soil, these being readily washed out of the soil by heavy rains when they are not taken up by the plants. The weights of the crops when harvested in 1897 were considerably below those of former years, and the general irregularities of the experiments indicated that the results as a whole would not warrant the usual analyses. In the tables giving the data of the experiments, therefore, only the weights of the crops at harvest are found for 1897*, and these are so unusually low that they are not included in the averages. The results of the experiments of 1898 and 1899 appear to be fairly normal.

EXPERIMENTS WITH CORN.

When these experiments were begun in 1895 two varieties of corn, "yellow flint" and "white flint," were grown. Analyses of samples of the grain used for seed in the first of the experiments, in 1895, showed a difference in the composition of the two varieties, the white flint corn having thirteen per cent. of protein in the dry matter of the grain, while the yellow flint contained only eleven per cent. The latter had been grown upon poor soil for many years.

* Except cow pea fodder, of which analyses also were made.

One object of the experiments was to determine whether the two varieties, which differed so much in composition at the beginning of the experiments, would still show the same difference after they had been grown for a period of years under the same conditions regarding methods of cultivation, kinds and amounts of fertilizer used, etc. For three years the experiments with these two varieties of corn were carried on, seed taken from the crop on each section in one year being saved for planting on the same section the following year. To prevent, if possible, a crossing of the varieties that might follow if they were grown on adjoining sections, the yellow flint corn was grown on the series of sections at the north end of the plots (Series A), and the white flint on the series of sections at the south end (Series F), the two series being about 175 feet apart. In spite of this separation a slight amount of mixing or crossing occurred during the first year (1895). Care was taken, however, in saving the seed for the following year, to select that which was believed to be unmixed. In 1896 the yellow flint corn, which was naturally somewhat slower than the white flint in reaching maturity, was planted a week later than the white flint, so that the blossoming of the two varieties might occur at different periods. In that year mixing or crossing of the varieties was apparently prevented. The seed from the experiments of 1896 was planted as usual in 1897, but in the wet, cool season of that year the yellow flint corn failed to mature sufficiently to warrant the use of the seed for planting in 1898; and as it was found impossible to secure more seed of the same variety from the grower who furnished in 1895 the seed used in the first of these experiments, the use of the yellow flint corn was discontinued in 1898, and since that time, as will be explained in a later paragraph, only white flint corn has been used.

The results of the experiments for 1895 and 1896 may be found in the Reports of the Station for those years. The results of the 1897 experiments are incorporated with those of 1898 and 1899 in the present article. As already explained, the crops grown in the experiments of 1897 were not analyzed, only the weights of the crops at harvest being given in the following tables; and these are so irregular that they are not

included in the general averages. No attempt is made, therefore, to draw conclusions concerning the effects of the fertilizers from the experiments of that year.

The experiments of 1895 and 1896 indicate, in brief, that as regards both yield and composition the nitrogenous fertilizers benefited greatly both the corn and the stover in the two varieties. The yields from the plots with nitrogenous fertilizers were considerably larger than those from the plots which had the mineral fertilizers only or no fertilizers at all. The proportion of protein in the crops was higher where nitrogen was used in the fertilizer, although the percentage of protein did not increase in proportion to the amount of nitrogen used. The percentage of protein in the seed taken from the 1896 crops for planting in 1897 was not so large in either variety as was found in the original seed planted in 1895; the average composition of the grain of each variety from all the plots showing only 11 per cent. of protein in the white flint in the latter season, as against 13 per cent. in the original sample; and the yellow flint 10.2 per cent. in the latter season as against 11 per cent. in the original sample. The experiment with the two varieties was not continued long enough, however, to draw any conclusions from these results regarding the relative tendencies to maintain, increase or diminish their percentages of nitrogen under the different methods of fertilizing.

Inasmuch as for lack of proper seed the experiment with yellow flint corn could not be continued, a new lot of white flint corn was obtained in 1898 from the grower who had furnished the seed of this variety in 1895, and this new lot of seed was planted on the sections (Series A) previously devoted to yellow flint corn, and since that time only the one variety—white flint—has been used in these experiments with corn. The sections (Series F) at the south end of the field, however, were planted with seed grown on the same sections in the preceding year. There was, therefore, a difference in the conditions under which the two lots of seed had been grown prior to 1898. Furthermore, a difference was made in the fertilizing of the two series (A and F), as explained in the next paragraph; lime being applied on Series A in addition to the regular fertilizers, while on Series F no lime was applied in addition. For these reasons it was thought best to keep the data from the two series separate, as is done in Tables 37 and 38.

In earlier experiments on this field it had been observed that yields from some of the plots of the sulphate of ammonia group were smaller than those from corresponding plots of the nitrate of soda group, the differences being most conspicuous in the cases where the largest amounts of the sulphate were used. Experiments* elsewhere, however, have given similar results, and suggest that the smaller yield with the sulphate of ammonia may be due to an acid condition of the soil resulting from the surplus sulphuric acid left as a residue in the soil after the nitrification of the ammonia of the sulphate. In these latter experiments air-slacked lime was applied for the purpose of neutralizing the acidity, apparently with excellent results. Accordingly, in the experiments at the Station in 1898, forty pounds of air-slacked lime was applied, in addition to the regular fertilizer, on each section in Series A at the north end of the field upon which the new lot of seed was planted in 1898. On the sections at the south end of the plots (Series F), which were planted with corn grown on the same sections, the fertilizers were applied without the additional lime. A comparison of the yields from the two series, the one with and the other without the extra lime, is given in the following table. The figures in this table are the averages of the results of the experiments of 1898 and 1899 given in Tables 37 and 38 following.

Yields of corn and stover from sections treated with lime compared with yields from sections not treated with lime.

Kind of Fertilizer.	Plot No.	Yields per Acre.			
		Series F, without lime.		Series A, with lime.	
		Shelled corn.	Stover.	Shelled corn.	Stover.
		bu.	lbs.	bu.	lbs.
Nothing,	0, 00	15.3	901	12.7	1139
Mixed minerals	6*a*, 6*b*	31.7	2216	36.6	2647
Nitrate of soda group,	7	28.8	2013	35.2	2575
	8	42.5	2480	52.6	3000
	9	43.6	2310	52.0	2675
Sulphate of ammonia group,	10	39.9	2463	48.6	2938
	11	44.0	2438	48.2	3600
	12	36.0	1995	51.4	3200

* For a discussion of the subject of the acidity of soils and the beneficial action of lime upon acid soils, see articles by H. J. Wheeler, Ph. D., in the Reports and Bulletins of the R. I. Experiment Station. See also U. S. Dept. Agr., Farmers' Bulletin, No. 77, The Liming of Soils, by the same author.

It will be observed that on the sections without additional lime the yield from plot 12, having the largest ration of sulphate of ammonia, was considerably smaller than that from plot 9, having the largest ration of nitrate of soda; while on the sections treated with lime in addition to the regular fertilizers the yield from plot 12 was practically the same as that from plot 9. If the difference between the yield with the sulphate and that with the nitrate is due to an acid condition of soil caused by the former material, then in this particular case it would seem not improbable that the sulphuric acid from the ammonium sulphate might have been neutralized by the lime. It is not meant by this, however, that the neutralizing of sulphuric acid set free by the nitrification of ammonia, or of acids otherwise formed in the soil, is the sole or necessarily the chief factor to be considered in explaining the beneficial action of lime. Indeed, the results of experiments for 1898 and 1899, as seen in the table above, show that the yields from all the fertilized sections, which were treated with lime in addition to the regular fertilizers (not considering the plots with no fertilizer), were better than the yields from sections without lime. The fact that where lime was used there was a considerable increase in the yields from the nitrate of soda group as well as in those from the sulphate of ammonia group of plots would seem to indicate that the lime had some direct beneficial effect upon the fertility of the soils aside from its neutralizing action, as nitrate of soda would hardly cause injurious acidity. It may be that the lime aided in the nitrification of the ammonia of the sulphate and of other nitrogen compounds present in the soil. In how far this may be the case these experiments are not calculated to indicate.

The amounts of nitrogen in the fertilizers and the yields of the crop.—The figures in the following tables are intended to show what increase in the total yield (corn and stover) accompanies the increase in the amount of nitrogen in the fertilizer. The yields from the sections (Series A) at the north ends of the plots are given in Table 37; those from sections at the south ends (Series F) in Table 38. The weights of the yields are given per section and per acre. The yields per section are determined by actual weighings of the crop from each section.

From these weighings and the size of the plots the corresponding yields per acre are calculated. By comparing the yields from the sections having different kinds and amounts of fertilizers the effect of the different fertilizers upon the yields may be estimated.

As might be expected, the yields from the sections of plots o and oo, which have received no fertilizer for over ten years, are poor. The yields from the section of plots 6*a* and 6*b*, which have only the mineral fertilizers, are much better than might be expected in consideration of the fact that no nitrogenous fertilizers of any kind have been applied upon these plots for more than ten years. In this respect the results of the experiments with corn are much better than those obtained in experiments with common grasses, such as timothy or red top, under similar conditions. This accords with the belief that corn may be better able than the common grasses to gather nitrogen from natural sources in the soil.

In the average of the results from both series of sections A and F for 1898 and 1899 the yields from the sections of plot 7, with the smaller ration of nitrate of soda, are smaller than those from the sections of the mineral plots, 6*a* and 6*b*. This smaller yield with nitrogenous fertilizers than without them is unusual, and the explanation is not apparent.

In comparing the yields of shelled corn from the sections of the different plots it will be noticed that, with one exception, the yields from the sections of the nitrate of soda group of plots, 7, 8, and 9, are largest from plot 9, upon which the largest ration—seventy-five pounds per acre—of nitrogen is used. It will be observed, however, that the yields from plot 9 are but little larger than those from plot 8, upon which only fifty pounds of nitrogen per acre are used; while in the exception noted above in 1899 the yield from section A of plot 8 was larger than that from the same section of any other plot. This generally small increase in yield of crop accompanying a relatively large increase in the quantity of nitrogen in the fertilizers would seem to indicate that the corn in this case could not utilize profitably the larger quantities of nitrogen when supplied in a readily soluble fertilizer such as nitrate of soda.

TABLE 37.

SPECIAL NITROGEN EXPERIMENTS ON WHITE* FLINT CORN (SERIES A).

Weight and cost of fertilizers per acre, total crop, and increase of crop over that of the nothing plots.

No. of Plot.	Fertilizers per Acre. Kind.	Weight.	Year.	Cost.	Yield per Sec. 1-50 Acre. Shelled corn.	Yield per Sec. 1-50 Acre. Stover.	Yield per Acre. Shelled corn.	Yield per Acre. Stover.	Gain over nothing plots.
		Lbs.		$	Lbs.	Lbs.	Bu.	Lbs.	Bu.
0	Nothing,	—	1897		2.7	23.5	2.4	1175	—
			1898		11.3	25.0	10.1	1250	—
			1899	—	12.2	19.6	10.9	980	—
			Av.†		**11.8**	**22.3**	**10.5**	**1115**	
7	Mixed Minerals, as No. 6*a*, -	480	1897	10.11	4.0	45.0	3.6	2250	−0.4
			1898	9.37	33.3	45.0	29.7	2250	15.5
	Nitrate of Soda, (25 lbs. N.),	160	1899	9.00	45.5	58.0	40.7	2900	29.4
			Av.†		**39.4**	**51.5**	**35.2**	**2575**	**22.5**
8	Mixed Minerals, as No. 6*a*, -	480	1897	13.61	12.5	29.5	11.2	1475	7.2
			1898	12.87	52.5	50.5	46.9	2525	32.7
	Nitrate of Soda, (50 lbs. N.),	320	1899	12.13	65.2	69.5	58.2	3475	46.9
			Av.†		**58.9**	**60.0**	**52.6**	**3000**	**39.8**
9	Mixed Minerals, as No. 6*a*, -	480	1897	17.11	10.6	31.5	9.5	1575	5.5
			1898	16.37	56.5	59.5	50.5	2975	36.3
	Nitrate of Soda, (75 lbs. N.),	480	1899	15.26	59.8	47.5	53.4	2375	42.1
			Av.†		**58.2**	**53.5**	**52.0**	**2675**	**39.2**
6*a*	Dis. Bone-black, Mixed	320	1897	6.61	11.1	25.0	9.9	1250	5.9
			1898	5.87	32.5	43.0	29.0	2150	14.8
	Mur. of Potash, Minerals,	160	1899	5.87	40.9	70.3	36.5	3515	25.2
			Av.†		**36.7**	**56.7**	**32.8**	**2833**	**20.0**
10	Mixed Minerals, as No. 6*a*, -	480	1897	9.99	21.3	34.5	19.0	1725	15.0
			1898	9.37	45.5	53.0	40.6	2650	26.4
	Sulph. of Am. (25 lbs. N.), -	120	1899	9.62	63.3	64.5	56.6	3225	45.3
			Av.†		**54.4**	**58.8**	**48.6**	**2938**	**35.9**
11	Mixed Minerals, as No. 6*a*, -	480	1897	13.37	27.0	37.0	24.1	1850	20.1
			1898	12.87	58.7	64.0	52.4	3200	38.2
	Sulph. of Am. (50 lbs. N.), -	240	1899	13.37	49.3	80.0	44.0	4000	32.7
			Av.†		**54.0**	**72.0**	**48.2**	**3600**	**35.5**
12	Mixed Minerals, as No. 6*a*, -	480	1897	16.75	27.0	41.0	24.1	2050	20.1
			1898	16.37	55.8	50.5	49.8	2525	35.6
	Sulph. of Am. (75 lbs. N.), -	360	1899	17.12	59.2	77.5	52.9	3875	41.6
			Av.†		**57.5**	**64.0**	**51.4**	**3200**	**38.6**
00	Nothing,	—	1897		6.3	22.0	5.6	1100	—
			1898		20.5	25.0	18.3	1250	—
			1899	—	13.0	21.5	11.6	1075	—
			Av.†		**16.8**	**23.3**	**15.0**	**1163**	
6*b*	Mixed Minerals, as No. 6*a*, -	480	1897	6.61	6.7	39.0	6.0	1950	2.0
			1898	5.87	45.0	41.0	40.2	2050	26.0
			1899	5.87	45.7	57.5	40.8	2875	29.5
			Av.†		**45.4**	**49.3**	**40.5**	**2463**	**27.8**

* Yellow flint corn in 1897.

† Average omitting 1897.

TABLE 38.

SPECIAL NITROGEN EXPERIMENTS ON WHITE FLINT CORN (SERIES F).

Weight and cost of fertilizers per acre, total crop, and increase of crop over that of the nothing plots.

No. of Plot.	Fertilizers per Acre. Kind.	Weight.	Year.	Cost.	Yield per Sec. 1-50 Acre. Shelled corn.	Yield per Sec. 1-50 Acre. Stover.	Yield per Acre. Shelled corn.	Yield per Acre. Stover.	Gain over nothing plots.
		Lbs.		$	Lbs.	Lbs.	Bu.	Lbs.	Bu.
0	Nothing,	—	1897		7.7	12.5	6.9	625	—
			1898		14.2	16.1	12.7	805	—
			1899	—	20.2	23.8	18.0	1190	—
			Av.*		**17.2**	**20.0**	**15.4**	**998**	—
7	Mixed Minerals, as No. 6*a*,	480	1897	10.11	24.7	26.0	22.1	1300	13.8
			1898	9.37	28.0	27.0	25.0	1350	10.1
	Nitrate of Soda, (25 lbs. N.),	160	1899	9.00	36.4	53.5	32.5	2675	16.7
			Av.*		**32.2**	**40.3**	**28.8**	**2013**	**13.4**
8	Mixed Minerals, as No. 6*a*,	480	1897	13.61	15.4	27.0	13.8	1350	5.5
			1898	12.87	47.7	44.2	42.6	2210	27.7
	Nitrate of Soda, (50 lbs. N.),	320	1899	12.13	47.4	55.0	42.3	2750	26.7
			Av.*		**47.6**	**49.6**	**42.5**	**2480**	**27.2**
9	Mixed Minerals, as No. 6*a*,	480	1897	17.11	31.5	25.0	28.1	1250	19.8
			1898	16.37	48.1	41.4	42.9	2070	28.0
	Nitrate of Soda, (75 lbs. N.),	480	1899	15.26	49.4	51.0	44.2	2550	28.4
			Av.*		**48.8**	**46.2**	**43.6**	**2310**	**28.2**
6*a*	Dis. Bone-black, Mixed Mur. of Potash, Minerals,	320	1897	6.61	25.9	22.0	23.1	1100	14.8
			1898	5.87	36.9	35.8	32.9	1790	18.0
		160	1899	5.87	33.0	52.0	29.5	2600	13.7
			Av.*		**35.0**	**43.9**	**31.2**	**2195**	**15.9**
10	Mixed Minerals, as No. 6*a*,	480	1897	9.99	29.9	33.0	26.7	1650	18.4
			1898	9.37	43.0	40.5	38.4	2025	23.5
	Sulph. of Am. (25 lbs. N.),	120	1899	9.62	46.3	58.0	41.3	2900	25.6
			Av.*		**44.7**	**49.3**	**39.9**	**2463**	**24.6**
11	Mixed Minerals, as No. 6*a*,	480	1897	13.37	39.6	33.0	35.4	1650	27.1
			1898	12.87	47.7	44.5	42.6	2225	27.7
	Sulph. of Am. (50 lbs. N.),	240	1899	13.37	50.8	53.0	45.4	2650	29.6
			Av.*		**49.3**	**48.8**	**44.0**	**2438**	**28.7**
12	Mixed Minerals, as No. 6*a*,	480	1897	16.75	38.5	32.0	34.4	1600	26.1
			1898	16.37	43.2	37.8	38.6	1890	23.7
	Sulph. of Am. (75 lbs. N.),	360	1899	17.12	36.4	42.0	33.4	2100	17.6
			Av.*		**39.8**	**39.9**	**36.0**	**1995**	**20.7**
00	Nothing,	—	1897		10.7	10.0	9.6	500	—
			1898		19.0	14.7	17.0	735	—
			1899	—	15.1	17.5	13.5	875	—
			Av.*		**17.1**	**16.1**	**15.3**	**805**	—
6*b*	Mixed Minerals, as No. 6*a*,	480	1897	6.61	25.3	29.0	22.6	1450	14.3
			1898	5.87	41.8	37.0	37.3	1850	22.4
			1899	5.87	30.3	52.5	27.1	2625	11.3
			Av.*		**36.1**	**44.8**	**32.2**	**2238**	**16.9**

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* Average omitting 1897.

From a comparison of the yields of shelled corn from all the sections in the same series it will be seen that the yields from the sections of the sulphate of ammonia group of plots—10, 11, and 12—correspond somewhat with those from the nitrate of soda group—7, 8, and 9—the most noticeable disagreement being that between the yields from section F of plot 12, with the large ration of sulphate of ammonia, and the yield from section F of plot 9, with the large ration of nitrate of soda. That the smaller yield from plot 12 may be due to acidity of the soil has already been suggested.

The amounts of nitrogen in the fertilizers and the proportion of protein in the crop.—The following tables are intended to illustrate, by the analyses of the crops, the apparent effects of the different fertilizers upon the composition of the plants, and especially the increase in the proportion of nitrogen in the crops following the increase in the quantity of nitrogen in the fertilizers. The results for the grain and the stover respectively are shown in Tables 39 and 40 for the sections (Series A) at the north end of the plots, and in Tables 41 and 42 for the sections (Series F) at the south end. The data in these tables include the weights per acre of the crops on the different sections at harvest, the percentages and amounts of dry matter and of protein in the crop, and a comparison—expressed in percentages in the last two columns—of the yields of dry matter and of protein from the sections of plots having nitrogen with the average of the yields from sections of the mineral plots. This comparison between the results from sections of the mineral plots and those from sections of plots with nitrogenous fertilizers in addition to the minerals shows the increase in dry matter and protein that follows the use of the nitrogenous fertilizers, and serves to indicate the relative effects of the different quantities of nitrogen upon the proportion of nitrogenous compounds (protein) in the crops.

We here follow common usage in multiplying the total nitrogen found by analysis by the factor 6.25 and designate the product as protein. It is, of course, understood that not all of the nitrogen is present in the plant in the form of true proteids. More or less occurs in non-proteid organic compounds. Small quantities are at times present in plants in the form of nitrates.

The methods for distinguishing between proteid and non-proteid nitrogen are not satisfactory. We nevertheless hope at some future time to inquire into the quantities of proteid and non-proteid nitrogen in the plants grown on the different plots in these experiments, even though there is little reason to believe that the results will prove of special importance. Had the resources of the Station allowed it this would have been done already.

In view of the possibility of the occurrence of nitrogen in the form of nitrates a number of tests were made for nitric acid in samples of crops from plots on which the nitrogenous fertilizers were applied, but the results of the tests were negative, as stated on page 174.

From the figures in these tables it will be noticed that in many instances the percentage of protein is higher in crops grown with no fertilizers than it is in crops grown with fertilizers. This same thing has been observed in previous experiments, and is explained in former Reports* as probably due to the fact that in the grain grown without fertilizers there is a large proportion of "poor" or "soft" kernels. These latter have been shown by analysis to contain a larger percentage of protein than is found in matured corn, owing possibly to an incomplete development of starch and oil in the immature seeds. In the crop from sections of the mineral plots (*6a* and *6b*) the percentages of protein are seen to be in nearly all cases smaller than in the crops from sections of plots with nitrogen. In plants from the nitrate of soda group of plots the percentages of protein were largest in both grain and stover from sections of plot 9. The increase, however, in the protein in the crops from sections of plot 9 over that in the crops from sections of plot 8 did not correspond in all cases to the increase in the quantity of nitrogen in the fertilizers. In many instances the percentage of protein in crops from sections of plot 9, with seventy-five pounds of nitrogen per acre, are but little larger than in those from sections of plots 8 or 7, with fifty or twenty-five pounds of nitrogen per acre. Similar facts are noticed in the results from the sulphate of ammonia group of plots.

* See p. 28 of the Report of this Station for 1890; also p. 136 of Report for 1898.

TABLE 39.

SPECIAL NITROGEN EXPERIMENTS ON WHITE FLINT CORN (SERIES A).

Percentages and pounds per acre of dry matter and of protein in the grain.

No. of Plot.	Fertilizers.	Weight of fertilizer.	Year.	Weight at harvest per acre.	Dry matter.		Protein in dry matter. N. × 6.25.		Percentage of yield on basis of yield from mineral plots.	
									Dry matter.	Protein.
		Lbs.		Lbs.	%	Lbs.	%	Lbs	%	%
0	Nothing,	—	1898	565	84.3	476	9.79	47	29	29
			1899	610	89.7	547	10.19	56	29	29
			Av.	**588**	**87.0**	**512**	**9.99**	**52**	**29**	**30**
7	Mixed Minerals, as No. 6*a*,	480	1898	1665	81.5	1357	10.35	140	82	87
	Nitrate of Soda (25 lbs. N.),	160	1899	2275	88.9	2022	10.31	209	106	109
			Av.	**1970**	**85.2**	**1690**	**10.33**	**175**	**95**	**99**
8	Mixed Minerals, as No. 6*a*,	480	1898	2625	84.6	2221	10.05	223	134	139
	Nitrate of Soda (50 lbs. N.),	320	1899	3260	86.5	2820	10.94	309	148	161
			Av.	**2943**	**85.6**	**2521**	**10.50**	**266**	**142**	**151**
9	Mixed Minerals, as No. 6*a*.	480	1898	2825	83.1	2348	10.60	249	142	155
	Nitrate of Soda (75 lbs. N.),	480	1899	2990	87.3	2610	11.37	297	137	155
			Av.	**2908**	**85.2**	**2479**	**10.99**	**273**	**139**	**155**
6*a*	Dis. Bone-black, Mixed	320	1898	1625	85.0	1381	9.70	134	*	*
	Mur. of Potash, Min'ls,	160	1899	2045	87.4	1787	10.31	184	*	*
			Av.	**1835**	**86.2**	**1584**	**10.01**	**159**	*	*
10	Mixed Minerals, as No. 6*a*,	480	1898	2275	83.4	1897	10.12	192	115	120
	Sulph. of Am. (25 lbs. N.),	120	1899	3165	85.4	2703	11.56	313	142	163
			Av.	**2720**	**84.4**	**2300**	**10.84**	**253**	**129**	**143**
11	Mixed Minerals, as No. 6*a*,	480	1898	2935	85.8	2518	9.98	251	152	156
	Sulph. of Am. (50 lbs. N.),	240	1899	2465	85.5	2108	11.63	245	111	128
			Av.	**2700**	**85.7**	**2313**	**10.81**	**248**	**130**	**141**
12	Mixed Minerals, as No. 6*a*,	480	1898	2790	85.1	2374	10.43	248	144	155
	Sulph. of Am. (75 lbs. N.),	360	1899	2960	86.2	2552	11.50	294	134	153
			Av.	**2875**	**85.7**	**2463**	**10.97**	**271**	**138**	**154**
00	Nothing,	—	1898	1025	83.2	853	10.59	90	52	56
			1899	650	89.6	582	11.19	65	31	34
			Av.	**836**	**86.4**	**718**	**10.89**	**78**	**40**	**44**
6*b*	Mixed Minerals, as No. 6*a*,	480	1898	2250	85.6	1926	9.71	187	*	*
			1899	2285	88.5	2022	9.87	200	*	*
			Av.	**2268**	**87.1**	**1974**	**9.79**	**194**	*	*

* The average of the yields on plots 6*a* and 6*b* is here taken at 100 for comparison.

TABLE 40.

SPECIAL NITROGEN EXPERIMENTS ON WHITE FLINT CORN (SERIES A).

Percentages and pounds per acre of dry matter and of protein in stover.

No. of Plot.	FERTILIZERS.	Weight of fertilizer.	Year.	Weight at harvest per acre.	Dry matter.		Protein in dry matter. N. × 6.25.		Percentage of yield on basis of yield from mineral plots.	
									Dry matter.	Protein.
		Lbs.		Lbs.	%	Lbs.	%	Lbs	%	%
0	Nothing,	—	1898	1250	68.6	858	7.84	67	62	73
			1899	980	68.3	669	9.00	60	36	52
			Av.	**1115**	**68.5**	**764**	**8.42**	**64**	**47**	**61**
7	Mixed Minerals, as No. 6*a*, Nitrate of Soda (25 lbs. N.)	480 160	1898	2250	64.3	1447	6.23	90	105	90
			1899	2900	57.2	1659	6.19	103	89	88
			Av.	**2575**	**60.8**	**1553**	**6.21**	**97**	**96**	**93**
8	Mixed Minerals, as No. 6*a*, Nitrate of Soda (50 lbs. N.),	480 320	1898	2525	70.3	1775	5.71	101	129	110
			1899	3475	62.7	2179	7.50	163	117	140
			Av.	**3000**	**66.5**	**1977**	**6.61**	**132**	**122**	**126**
9	Mixed Minerals, as No. 6*a*, Nitrate of Soda (75 lbs. N.),	480 480	1898	2975	58.0	1726	6.25	108	126	118
			1899	2375	56.5	1342	7.19	97	72	83
			Av.	**2675**	**57.3**	**1534**	**6.72**	**103**	**95**	**99**
6*a*	Dis. Bone-black, Mixed Mur. of Potash, Min'ls,	320 160	1898	2150	62.8	1350	6.81	92	*	*
			1899	3515	57.9	2035	6.62	135	*	*
			Av.	**2833**	**60.4**	**1693**	**6.72**	**114**	*	*
10	Mixed Minerals, as No. 6*a*, Sulph. of Am. (25 lbs. N.),	480 120	1898	2650	66.4	1760	5.83	103	128	113
			1899	3225	60.7	1958	7.81	153	105	131
			Av.	**2938**	**63.6**	**1859**	**6.82**	**128**	**115**	**122**
11	Mixed Minerals, as No. 6*a*, Sulph. of Am. (50 lbs. N.),	480 240	1898	3200	57.6	1843	6.09	112	134	122
			1899	4000	55.0	2200	7.94	175	118	150
			Av.	**3600**	**56.3**	**2022**	**7.02**	**144**	**125**	**138**
12	Mixed Minerals, as No. 6*a*, Sulph. of Am. (75 lbs. N.),	480 360	1898	2525	61.6	1555	6.82	106	113	116
			1899	3875	50.4	1953	8.19	160	105	137
			Av.	**3200**	**56.0**	**1754**	**7.51**	**133**	**108**	**127**
00	Nothing,	—	1898	1250	62.0	775	9.08	70	56	77
			1899	1075	68.1	732	11.63	85	39	73
			Av.	**1163**	**65.1**	**754**	**10.36**	**78**	**47**	**75**
6*b*	Mixed Minerals, as No. 6*a*,	480	1898	2050	68.2	1398	6.47	91	*	*
			1899	2875	58.7	1688	5.81	98	*	*
			Av.	**2463**	**63.5**	**1543**	**6.14**	**95**	*	*

* The average of the yields on plots 6*a* and 6*b* is here taken at 100 for comparison.

TABLE 41.

SPECIAL NITROGEN EXPERIMENTS ON WHITE FLINT CORN (SERIES F).

Percentages and pounds per acre of dry matter and of protein in the grain.

No. of Plot.	FERTILIZERS.	Weight of fertilizer.	Year.	Weight at harvest per acre.	Dry matter.		Protein in dry matter. N. × 6.25.		Percentage of yield on basis of yield from mineral plots.	
									Dry matter.	Protein.
		Lbs.		Lbs.	%	Lbs.	%	Lbs	%	%
0	Nothing, - - - - -	—	1898	710	88.2	626	10.70	67	37	41
			1899	1010	88.3	892	11.19	100	65	78
			Av.	**860**	**88.3**	**759**	**10.95**	**84**	**49**	**57**
7	Mixed Minerals, as No. 6*a*,	480	1898	1400	85.6	1198	10.51	126	71	76
	Nitrate of Soda (25 lbs. N.),	160	1899	1820	88.8	1616	10.00	162	117	126
			Av.	**1610**	**87.2**	**1407**	**10.26**	**144**	**92**	**98**
8	Mixed Minerals, as No. 6*a*,	480	1898	2385	86.1	2053	10.39	213	121	129
	Nitrate of Soda (50 lbs. N.),	320	1899	2370	88.7	2102	10.00	210	152	163
			Av.	**2378**	**87.4**	**2078**	**10.20**	**212**	**135**	**144**
9	Mixed Minerals, as No. 6*a*,	480	1898	2405	84.9	2042	11.41	233	121	141
	Nitrate of Soda (75 lbs. N.),	480	1899	2470	86.4	2134	11.12	237	155	184
			Av.	**2438**	**85.7**	**2088**	**11.27**	**235**	**136**	**159**
6*a*	Dis. Bone-black, Mixed	320	1898	1845	86.6	1598	9.75	156	*	*
	Mur. of Potash, Min'ls,	160	1899	1650	87.1	1437	9.13	131	*	*
			Av.	**1748**	**86.9**	**1518**	**9.44**	**144**	*	*
10	Mixed Minerals, as No. 6*a*,	480	1898	2150	84.4	1815	10.60	192	107	116
	Sulph. of Am. (25 lbs. N.),	120	1899	2315	88.7	2053	10.06	207	149	161
			Av.	**2233**	**86.6**	**1934**	**10.33**	**200**	**126**	**136**
11	Mixed Minerals, as No. 6*a*,	480	1898	2385	83.6	1994	10.54	210	118	127
	Sulph. of Am. (50 lbs. N.),	240	1899	2540	88.1	2238	10.63	238	162	185
			Av.	**2463**	**85.9**	**2116**	**10.59**	**224**	**138**	**152**
12	Mixed Minerals, as No. 6*a*,	480	1898	2160	84.5	1825	10.80	197	108	119
	Sulph. of Am. (75 lbs. N.),	360	1899	1820	86.2	1569	10.81	170	114	132
			Av.	**1990**	**85.4**	**1697**	**10.81**	**184**	**111**	**125**
00	Nothing, - - - - -	—	1898	950	84.9	807	10.90	88	48	53
			1899	755	87.3	659	11.19	74	48	58
			Av.	**853**	**86.1**	**733**	**11.05**	**81**	**48**	**55**
6*b*	Mixed Minerals, as No. 6*a*,	480	1898	2090	85.3	1783	9.82	175	*	*
			1899	1515	87.2	1321	9.56	126	*	*
			Av.	**1803**	**86.3**	**1552**	**9.69**	**151**	*	*

* The average of the yields on plots 6*a* and 6*b* is here taken at 100 for comparison.

TABLE 42.

SPECIAL NITROGEN EXPERIMENTS ON WHITE FLINT CORN (SERIES F).

Percentages and pounds per acre of dry matter and of protein in stover.

No. of Plot.	FERTILIZERS.	Weight of fertilizer.	Year.	Weight at harvest per acre.	Dry matter.		Protein in dry matter. N. × 6.25.		Percentage of yield on basis of yield from mineral plots.	
									Dry matter.	Protein.
		Lbs.		Lbs.	%	Lbs.	%	Lbs	%	%
0	Nothing,	—	1898	805	76.5	616	5.80	36	48	54
			1899	1190	72.7	865	8.56	74	50	64
			Av.	**998**	**74.6**	**741**	**7.18**	**55**	**49**	**60**
7	Mixed Minerals, as No. 6*a*, Nitrate of Soda (25 lbs. N.),	480 160	1898	1350	72.9	984	5.17	51	76	77
			1899	2675	61.2	1637	8.12	133	95	114
			Av.	**2013**	**67.1**	**1311**	**6.65**	**92**	**87**	**100**
8	Mixed Minerals, as No. 6*a*, Nitrate of Soda (50 lbs. N.),	480 320	1898	2210	73.6	1627	5.57	91	126	137
			1899	2750	69.9	1922	8.69	167	112	143
			Av.	**2480**	**71.8**	**1775**	**7.13**	**129**	**118**	**140**
9	Mixed Minerals, as No. 6*a*, Nitrate of Soda (75 lbs. N.),	480 480	1898	2070	63.6	1317	6.62	87	102	131
			1899	2550	61.2	1561	11.31	177	91	152
			Av.	**2310**	**62.4**	**1439**	**8.97**	**132**	**95**	**143**
6*a*	Dis. Bone-black, Mixed Mur. of Potash, Min'ls,	320 160	1898	1790	70.9	1269	5.35	68	*	*
			1899	2600	64.3	1672	7.50	125	*	*
			Av.	**2195**	**67.6**	**1471**	**6.43**	**97**	*	*
10	Mixed Minerals, as No. 6*a*, Sulph. of Am. (25 lbs. N.),	480 120	1898	2025	73.3	1484	4.67	69	115	104
			1899	2900	65.2	1891	7.38	140	110	120
			Av.	**2463**	**69.3**	**1688**	**6.03**	**105**	**112**	**114**
11	Mixed Minerals, as No. 6*a*, Sulph. of Am. (50 lbs. N.),	480 240	1898	2225	66.9	1489	5.08	76	115	114
			1899	2650	65.8	1744	12.69	221	101	190
			Av.	**2438**	**66.4**	**1617**	**8.89**	**149**	**107**	**162**
12	Mixed Minerals, as No. 6*a*, Sulph. of Am. (75 lbs. N.),	480 360	1898	1890	70.9	1340	5.55	74	104	111
			1899	2100	63.6	1336	14.75	197	78	169
			Av.	**1995**	**67.3**	**1338**	**10.15**	**136**	**89**	**148**
00	Nothing,	—	1898	735	70.0	515	8.30	43	40	65
			1899	875	71.9	629	10.37	65	37	56
			Av.	**805**	**71.0**	**572**	**9.34**	**54**	**38**	**59**
6*b*	Mixed Minerals, as No. 6*a*,	480	1898	1850	71.3	1319	4.89	65	*	*
			1899	2625	67.6	1775	6.06	108	*	*
			Av.	**2238**	**69.5**	**1547**	**5.48**	**87**	*	*

* The average of the yields on plots 6*a* and 6*b* is here taken at 100 for comparison.

In comparing the results of the experiments for 1898 with those for 1899, it will be noticed that in 1898 the increase in the percentages of protein in the crops which might be ascribed to an increase in the nitrogen in the fertilizer was much less noticeable, on the whole, and corresponded much less regularly with the increase in the quantities of nitrogen used than was the case in 1899. This may be due in part to exceptionally heavy rains in July and August,* 1898, which seemed to curtail the yields and may also have modified the effects of nitrogen on the protein of the crop. As suggested in a preceding paragraph, excessive rain during the growing season may cause considerable of the nitrogen in soluble materials, as nitrates, etc., to be washed away in drainage water, and by thus reducing the amount of nitrogen available to the plants may modify the effect upon both the yield and the composition of the crop.

EXPERIMENTS WITH COW PEAS.

From the diagram on page 172, which illustrates the method of dividing each of the plots in the experimental field into six equal sections one-fiftieth of an acre in size, and shows what crop is grown on each section, it will be seen that cow peas are grown on the two series of sections lettered C and D. The kinds and amounts of fertilizer used on each plot are shown in the diagram on page 170.

The Clay variety of cow peas are used in these experiments. The seed is obtained each year from Tennessee, because it has been found that in this climate cow peas do not mature sufficiently to use the seed grown in the experiments of one year for planting the following year. On the two series of sections, C and D, the cow peas are planted in drills at the rate of about forty quarts per acre. Although the two series of sections are kept separate in growing the crops, the data from both are combined and the results of the experiments are given as if obtained from one series of sections, each one-twenty-fifth of an acre in size.

The results of the experiments for 1897, 1898, and 1899 are given in Tables 43 and 44 which follow. The weights at harvest of the crops on the different sections are given per section and per acre in Table 43; but the figures for the 1897

* See Meteorological observations on p. 245 of the Report for 1898.

experiments are not included in the averages in the table because of the irregularity of the experiments of that year, as above explained. Table 44 gives the percentages and amounts of dry matter in the crop at harvest, and of protein in the dry matter. The analyses for 1897 are also given in this table, but are not included in the averages. These are the only analyses made of any of the crops grown in the special nitrogen experiments of 1897.

The amounts of nitrogen in the fertilizers and the total yields of the crop.—The results of the special nitrogen experiments in their bearing upon the effect of the different fertilizers upon the total yield of the crop are shown in the figures in Table 43. From these figures it will be seen that the yields from all the fertilized plots are about twice as large as those from the plots with no fertilizer. The most noticeable feature of these results is the large yields from the sections of the plots (*6a* and *6b*), with the mineral fertilizers only, as compared with the yields from the sections of plots having the nitrogenous fertilizers in addition to the minerals. The average of the yields from the sections of the two mineral plots is larger than the yield from either one of a number of the sections of plots with nitrogen. Even where an increase in yield accompanies the application of the nitrogenous fertilizers, the amount of increase does not correspond at all with the quantities of nitrogen used. For instance, in the experiments of both 1898 and 1899, the yield from the sections of plot 7 of the nitrate of soda group, with twenty-five pounds of nitrogen per acre, was larger than that from the sections of either plot 8 or 9 of the same group, with fifty and seventy-five pounds per acre respectively, or from sections of the plots—10, 11, and 12—of the sulphate of ammonia group. The inference from these results is that, so far as the growth of the plants is concerned, good returns follow the application of the mineral fertilizers upon cow peas, but the application of nitrogen has little effect upon the yield.

In the experiments of 1898 the total yield of this crop from the sulphate of ammonia group of plots was practically the same as that from the nitrate of soda group. In the 1899 experiments, however, and in all other experiments with this crop during the past five years, except those of 1898, the yields of cow pea fodder were, on the whole, smaller from the sulphate of ammonia group than from the nitrate of soda group.

TABLE 43.

SPECIAL NITROGEN EXPERIMENTS ON COW PEA FODDER.

Weight and cost of fertilizers per acre, total crop, and increase of crop over that of the nothing plots.

No. of Plot.	Fertilzers.	Weight of fertilizer.	Year.	Cost of fertilizer.	Yield per section. 1-25 acre.	Yield per acre as harvested.		Gain over nothing plots.
		Lbs.		$	Lbs.	Lbs.	Tons	Lbs.
0	Nothing,	—	1897	—	392	9800	4.9	—
			1898	—	456	11400	5.7	—
			1899	—	430	10750	5.4	—
			Av.*	—	**443**	**11075**	**5.6**	—
7	Mixed Minerals, as No. 6*a*,	480	1897	10.11	814	20350	10.2	12200
			1898	9.37	958	23950	12.0	13450
	Nitrate of Soda (25 lbs. N.),	160	1899	9.00	910	22750	11.4	13187
			Av.*	—	**934**	**23350**	**11.7**	**13319**
8	Mixed Minerals, as No. 6*a*,	480	1897	13.61	766	19150	9.6	11000
			1898	12.87	886	22150	11.2	11650
	Nitrate of Soda (50 lbs. N.),	320	1899	12.13	875	21875	10.9	12312
			Av.*	—	**881**	**22013**	**11.1**	**11981**
9	Mixed Minerals, as No. 6*a*,	480	1897	17.11	676	16900	8.5	8750
			1898	16.37	930	23250	11.6	12750
	Nitrate of Soda (75 lbs. N.),	480	1899	15.26	852	21300	10.7	11737
			Av.*	—	**891**	**22275**	**11.2**	**12244**
6*a*	Dis. Bone-black, Mixed	320	1897	6.61	822	20550	10.3	12400
			1898	5.87	922	23050	11.5	12550
	Mur. of Potash, Minerals,	160	1899	5.87	850	21250	10.6	11687
			Av.*	—	**886**	**22150**	**11.1**	**12119**
10	Mixed Minerals, as No. 6*a*,	480	1897	9.99	692	17300	8.7	9150
			1898	9.37	906	22650	11.3	12150
	Sulph. of Am. (25 lbs. N.),	120	1899	9.62	845	21125	10.6	11562
			Av.*	—	**876**	**21888**	**11.0**	**11856**
11	Mixed Minerals, as No. 6*a*,	480	1897	13.37	666	16650	8.3	8500
			1898	12.87	934	23350	11.7	12850
	Sulph. of Am. (50 lbs. N.),	240	1899	13.37	765	19125	9.6	9562
			Av.*	—	**850**	**21238**	**10.7**	**11206**
12	Mixed Minerals, as No. 6*a*,	480	1897	16.75	604	15100	7.6	6950
			1898	16.37	926	23150	11.6	12650
	Sulph. of Am. (75 lbs. N.),	360	1899	17.12	770	19250	9.6	9687
			Av.*	—	**848**	**21200**	**10.6**	**11169**
00	Nothing,	—	1897	—	260	6500	3.3	—
			1898	—	384	9600	4.8	—
			1899	—	335	8375	4.2	—
			Av.*	—	**360**	**8988**	**4.5**	—
6*b*	Mixed Minerals, as No. 6*a*,	480	1897	6.61	744	18600	9.3	10450
			1898	5.87	880	22000	11.0	11500
			1899	5.87	893	22325	11.2	12762
			Av.*	—	**887**	**22163**	**11.1**	**12131**

* Average omitting 1897.

In the case of corn, in which similar results have been noted, the smaller yield with the sulphate has been explained as possibly due to an acidity of soil resulting from the repeated application of this material to the same plots year after year. The exception in 1898 noted above may, perhaps, be the result of the exceptional rainfall of 1897, and heavy rains also in 1898, which may have washed considerable of the surplus acid out of the soil at that time. No experiments have been made by the Station to test the advantages of lime upon the sections of the sulphate of ammonia plots upon which cow peas are grown.

The amounts of nitrogen in the fertilizers and the proportions of protein in the crop.—From Table 44 below, giving the percentages and amounts of dry matter in the crop at harvest and the percentages and amounts of protein in the dry matter, it will be seen that in many instances the percentages of protein are larger in the crops from sections of plots without fertilizers than in those from sections of plots with fertilizers. This has been noticed in the case of corn also, and may, perhaps, be due to premature ripening of the plants on the sections without fertilizer. It has been shown by analyses that the proportion of protein is larger in immature, or "poor" corn, than in mature, or "good" corn.

From the results given in Table 44 there appears to be but little relationship between the quantity of nitrogen in the fertilizer and the proportion of protein in the crop. In the 1898 experiments the percentage of protein was higher in the average of the crops from the sections of the two mineral plots than in the crop from sections of any of the plots with nitrogen. In the 1899 experiments, however, there appeared to be some increase in the proportion of protein in the crop accompanying the increase in the nitrogen in the fertilizer, as may be seen by comparing with each other the percentages of protein in the crops from sections of plots 7, 8, and 9, with respectively 25, 50, and 75 pounds of nitrogen in nitrate of soda, and also those from sections of plots 10, 11, and 12, with like amounts of nitrogen in sulphate of ammonia. In the experiments with cow peas, as a whole, the increase in the protein in the crop which accompanies the application of the nitrogen in the fertilizers, as shown by figures for percentages and yields of protein per acre, has been smaller and less uniform than in the experiments with common grasses.

TABLE 44.

SPECIAL NITROGEN EXPERIMENTS ON COW PEA FODDER.

Percentages and pounds per acre of dry matter and of protein.

No. of Plot.	Fertilizers.	Weight of fertilizer.	Year.	Weight at harvest per acre.	Dry matter.		Protein in dry matter. N. × 6.25.		Percentage of yield on basis of yield from mineral plots.	
									Dry matter.	Protein.
		Lbs.		Lbs.	%	Lbs.	%	Lbs.	%	%
0	Nothing,	—	1897	9800	18.5	1813	21.69	393	56	65
			1898	11400	18.9	2155	16.26	350	58	50
			1899	10750	16.3	1752	20.81	365	54	55
			Av.*	**11075**	**17.6**	**1954**	**18.54**	**358**	**56**	**56**
7	Mixed Minerals, as No. 6*a*, Nitrate of Soda (25 lbs. N.),	480 160	1897	20350	17.8	3622	17.68	640	112	106
			1898	23950	18.1	4335	16.38	710	116	101
			1899	22750	14.8	3367	21.06	709	104	106
			Av.*	**23350**	**16.5**	**3851**	**18.72**	**710**	**110**	**112**
8	Mixed Minerals, as No. 6*a*, Nitrate of Soda (50 lbs. N.),	480 320	1897	19150	17.8	3409	19.03	649	106	107
			1898	22150	17.5	3876	16.91	655	104	93
			1899	21875	15.2	3325	19.69	655	103	98
			Av.*	**22013**	**16.4**	**3601**	**18.30**	**655**	**103**	**103**
9	Mixed Minerals, as No. 6*a*, Nitrate of Soda (75 lbs. N.),	480 480	1897	16900	17.1	2890	18.43	533	90	88
			1898	23250	18.6	4325	17.51	757	116	108
			1899	21300	14.8	3152	22.94	723	97	108
			Av.*	**22275**	**16.7**	**3739**	**20.23**	**740**	**107**	**117**
6*a*	Dis. Bone-black, Mixed Mur. of Potash, Min.,	320 160	1897	20550	16.2	3329	19.25	641	†	†
			1898	23050	17.3	3988	17.98	717	†	†
			1899	21250	15.0	3188	21.12	673	†	†
			Av.*	**22150**	**16.2**	**3588**	**19.55**	**695**	†	†
10	Mixed Minerals, as No. 6*a*, Sulph. of Am. (25 lbs. N.),	480 120	1897	17300	16.5	2855	18.43	526	88	87
			1898	22650	17.9	4055	16.82	682	108	97
			1899	21125	15.7	3317	20.07	666	103	100
			Av.*	**21888**	**16.8**	**3686**	**18.45**	**674**	**106**	**106**
11	Mixed Minerals, as No. 6*a*, Sulph. of Am. (50 lbs. N.),	480 240	1897	16650	17.2	2864	15.91	456	89	75
			1898	23350	17.0	3970	17.99	714	106	102
			1899	19125	15.3	2926	20.88	611	90	91
			Av.*	**21238**	**16.2**	**3448**	**19.44**	**663**	**99**	**104**
12	Mixed Minerals, as No. 6*a*, Sulph. of Am. (75 lbs. N.),	480 360	1897	15100	18.0	2718	22.79	619	84	102
			1898	23150	16.8	3889	17.03	662	104	94
			1899	19250	14.2	2734	22.94	627	85	94
			Av.*	**21200**	**15.5**	**3312**	**19.99**	**645**	**95**	**102**
00	Nothing,	—	1897	6500	18.9	1229	18.13	223	38	37
			1898	9600	18.9	1814	17.87	324	48	46
			1899	8375	16.2	1357	23.31	316	42	47
			Av.*	**8988**	**17.6**	**1586**	**20.59**	**320**	**45**	**50**
6*b*	Mixed Minerals, as No. 6*a*,	480	1897	18600	16.8	3125	18.17	568	†	†
			1898	22000	15.9	3498	19.57	685	†	†
			1899	22325	14.7	3282	20.19	663	†	†
			Av.*	**22163**	**15.3**	**3390**	**19.88**	**674**	†	†

* Average omitting 1897.

† The average of the yields on plots 6*a* and 6*b* is here taken at 100 for comparison.

EXPERIMENTS WITH SOY BEANS.

As seen by the diagram on page 172 soy beans are grown upon the two series of sections lettered B and E. In the experiments with this crop, as in those with cow peas, the two series are used for growing the crops, but the results obtained on both are combined and reported as if only one series of sections twice the size were used. The results of the experiments with this crop are given in Tables 45 and 46 following. The experiments with this crop in 1896 are also included here, inasmuch as they have not been reported previously. The averages in the tables, therefore, include the results of three years—1896, 1898, and 1899—instead of two as in the case of corn and cow peas. The weights of the yields for 1897 are given in Table 45, but, as previously explained, they are not included in the averages nor considered in the discussion.

In these experiments with soy beans only the seed is taken into account. No attempt was made to estimate the yields of the vines after the seed was removed, because by the time the seed is well matured nearly all of the leaves have fallen from the vines.

The amounts of nitrogen in the fertilizers and the total yield of the crop.—The results of the experiments as regards the yields of the crop, given in Table 45 below, show that in many cases the yields from sections of plots with mineral fertilizers only were smaller than from sections of plots with nitrogen in addition to the minerals. The differences, on the whole, are more noticeable in the experiments with soy beans than in those with cow peas, suggesting that probably the nitrogenous fertilizers had more effect in increasing the yields of the soy beans. The total increase in the yields, however, accompanying the increase in the nitrogen of the fertilizer, did not correspond with the amounts of nitrogen used. In the experiments with soy beans here reported, in no case was the yield largest from the section of the plot with the largest quantity of nitrogen in the nitrate of soda group, and only in one case in the sulphate of ammonia group. The largest yields, on the average, were generally obtained from sections of plots with nitrogen at fifty pounds per acre. The value of the increase, however, which might be attributed to the nitrogenous fertilizers, was not sufficient in most cases to cover the cost of the nitrogen added to the mineral fertilizers.

TABLE 45.

SPECIAL NITROGEN EXPERIMENTS ON SOY BEAN SEED.

Weight and cost of fertilizers per acre, total crop, and increase of crop over that of the nothing plots.

No. of Plot.	Fertilizers.	Weight of fertilizer.	Year.	Cost of fertilizer.	Yield per section. 1-25 acre.	Yield per acre.		Gain over nothing plots.
		Lbs.		$	Lbs.	Lbs.	Bu.	Bu.
0	Nothing,	—	1896	—	23.6	590	9.8	—
			1897	—	9.0	225	3.8	—
			1898	—	19.6	490	8.2	—
			1899	—	30.2	755	12.6	—
			Av.*	—	**24.5**	**61.2**	**10.2**	—
7	Mixed Minerals, as No. 6*a*,	480	1896	9.99	39.9	998	16.6	5.5
			1897	10.11	23.6	590	9.8	6.1
	Nitrate of Soda (25 lbs. N.),	160	1898	9.37	33.6	840	14.0	5.9
			1899	9.00	42.8	1070	17.8	5.7
			Av.*	—	**38.8**	**969**	**16.1**	**5.7**
8	Mixed Minerals, as No. 6*a*,	480	1896	13.37	41.8	1045	17.4	6.3
			1897	13.61	13.9	348	5.8	2.1
	Nitrate of Soda (50 lbs. N.),	320	1898	12.87	40.1	1003	16.7	8.6
			1899	12.13	48.8	1220	20.3	8.2
			Av.*	—	**43.6**	**1089**	**18.1**	**7.7**
9	Mixed Minerals, as No. 6*a*,	480	1896	16.75	40.4	1010	16.8	5.7
			1897	17.11	17.6	440	7.3	3.6
	Nitrate of Soda (75 lbs. N.),	480	1898	16.37	36.2	905	15.1	7.0
			1899	15.26	48.7	1218	20.3	8.2
			Av.*	—	**41.8**	**1044**	**17.4**	**7.0**
6*a*	Dis. Bone-black, Mixed Mur. of Potash, Minerals,	320 160	1896	6.61	37.4	935	15.6	4.5
			1897	6.61	11.4	285	4.8	1.1
			1898	5.87	31.5	788	13.1	5.0
			1899	5.87	38.4	960	16.0	3.9
			Av.*	—	**35.8**	**894**	**14.9**	**4.5**
10	Mixed Minerals, as No. 6*a*,	480	1896	10.36	38.6	965	16.1	5.0
			1897	9.99	8.6	215	3.6	.1
	Sulph. of Am. (25 lbs. N.),	120	1898	9.37	30.4	760	12.7	4.6
			1899	9.62	41.7	1043	17.4	5.3
			Av.*	—	**36.9**	**923**	**15.4**	**5.0**
11	Mixed Minerals, as No. 6*a*,	480	1896	14.11	38.8	970	16.2	5.1
			1897	13.37	15.4	385	6.4	2.7
	Sulph. of Am. (50 lbs. N.),	240	1898	12.87	36.0	900	15.0	6.9
			1899	13.37	43.9	1098	18.3	6.2
			Av.*	—	**39.6**	**989**	**16.5**	**6.1**
12	Mixed Minerals, as No. 6*a*,	480	1896	17.86	42.0	1050	17.5	6.4
			1897	16.75	17.0	425	7.1	3.4
	Sulph. of Am. (75 lbs. N.),	360	1898	16.37	35.2	880	14.7	6.6
			1899	17.12	43.3	1083	18.1	6.0
			Av.*	—	**40.2**	**1004**	**16.8**	**6.3**

* Average omitting 1897.

TABLE 45.—*(Continued.)*

No. of Plot.	FERTILIZERS.	Weight of fertilizer.	Year.	Cost of fertilizer.	Yield per section, 1-25 acre.	Yield per acre.		Gain over nothing plots.
		Lbs.		$	Lbs.	Lbs.	Bu.	Bu.
00	Nothing, - - - - -	—	1896	—	28.0	750	12.5	—
			1897	—	8.4	210	3.5	—
			1898	—	19.2	480	8.0	—
			1899	—	27.5	688	11.5	—
			Av.*	—	**24.9**	**639**	**10.7**	—
6*b*	Mixed Minerals, as No. 6*a*, -	480	1896	6.61	36.9	923	15.4	4.3
			1897	6.61	14.9	373	6.2	2.5
			1898	5.87	38.7	968	16.1	8.0
			1899	5.87	44.7	1118	18.6	6.5
			Av.*	—	**40.1**	**1003**	**16.7**	**6.3**

* Average omitting 1897.

The amounts of nitrogen in the fertilizers and the proportion of protein in the crop.—As seen by the figures in Table 46 below, the percentage of protein in the crop from the plots with minerals only is in some cases smaller and in others larger than in the crop from the sections of plots with nitrogen in addition to the minerals. The average of the yields from the sections of both the mineral plots is somewhat smaller than the average yield from any of the sections of plots with nitrogen; but because of the irregularity in this respect it can hardly be said that a lack of nitrogen in the fertilizer was accompanied by a smaller percentage of protein in the crop. In the crops from the sections of plots with the nitrogenous fertilizers, in the experiments of 1896 and 1899, the percentage of protein was largest where the largest quantities of nitrogen were used. The experiments of 1898, as has been suggested in the discussion of experiments with other crops, may have been modified by heavy rains in the growing season.

It will be observed from the figures in Table 46, that not only the percentage of protein in the crop, but also the total yields of protein per acre were largest in several cases where the largest quantities of nitrogen were used in the fertilizers. On the whole, the experiments with this crop seem to indicate that the nitrogenous fertilizers tend to increase the yields of dry matter and of protein more than was found in the experiments with cow peas, but the increase does not correspond with the amounts of nitrogen used.

TABLE 46.

SPECIAL NITROGEN EXPERIMENTS ON SOY BEAN SEED.

Percentages and pounds per acre of dry matter and of protein.

No. of Plot.	Fertilizers.	Weight of fertilizer.	Year.	Weight at harvest per acre.	Dry matter.		Protein in dry matter. N. × 6.25.		Percentage of yield on basis of yield from mineral plots.	
									Dry matter.	Protein.
		Lbs.		Lbs.	%	Lbs.	%	Lbs.	%	%
0	Nothing,	—	1896	590	94.5	558	38.14	213	63	63
			1898	490	93.2	457	44.21	202	57	60
			1899	755	90.8	686	42.50	292	71	76
			Av.	**612**	**92.8**	**567**	**41.62**	**236**	**64**	**66**
7	Mixed Minerals, as No. 6*a*, Nitrate of Soda (25 lbs. N.),	480 160	1896	998	96.3	961	37.58	361	109	106
			1898	840	90.9	764	44.91	343	96	101
			1899	1070	91.8	982	40.57	398	102	103
			Av.	**969**	**93.0**	**902**	**41.02**	**367**	**102**	**103**
8	Mixed Minerals, as No. 6*a*, Nitrate of Soda (50 lbs. N.),	480 320	1896	1045	96.4	1007	38.00	383	114	112
			1898	1003	91.4	917	44.77	411	115	121
			1899	1220	92.6	1130	40.06	453	117	117
			Av.	**1089**	**93.5**	**1018**	**40.94**	**416**	**115**	**117**
9	Mixed Minerals, as No. 6*a*, Nitrate of Soda (75 lbs. N.),	480 480	1896	1010	96.2	972	38.09	370	110	109
			1898	905	91.0	824	44.40	366	103	108
			1899	1218	91.7	1117	41.31	461	116	119
			Av.	**1044**	**93.0**	**971**	**41.27**	**399**	**110**	**112**
6*a*	Dis. Bone-black, Mixed Mur. of Potash, Min.,	320 160	1896	935	95.1	889	38.32	341	†	†
			1898	788	91.8	723	42.23	305	†	†
			1899	960	92.2	885	41.57	368	†	†
			Av.	**894**	**93.0**	**832**	**40.71**	**338**	†	†
10	Mixed Minerals, as No. 6*a*, Sulph. of Am. (25 lbs. N.),	480 120	1896	965	97.2	938	41.45	389	106	114
			1898	760	90.7	689	41.64	387	86	114
			1899	1043	91.2	951	40.94	389	99	101
			Av.	**923**	**93.0**	**859**	**41.34**	**355**	**97**	**100**
11	Mixed Minerals, as No. 6*a*, Sulph. of Am. (50 lbs. N.),	480 240	1896	970	96.3	934	41.93	392	106	115
			1898	900	90.5	815	42.54	347	102	102
			1899	1098	91.6	1006	40.88	411	105	106
			Av.	**989**	**92.8**	**918**	**41.78**	**383**	**104**	**108**
12	Mixed Minerals, as No. 6*a*, Sulph. of Am. (75 lbs. N.),	480 360	1896	1050	95.4	1002	42.12	422	113	124
			1898	880	90.7	798	42.05	336	100	99
			1899	1083	91.7	993	43.25	420	103	109
			Av.	**1004**	**92.6**	**931**	**42.47**	**396**	**106**	**111**
00	Nothing,	—	1896	750	95.0	713	37.27	266	81	78
			1898	480	91.6	440	45.65	201	55	59
			1899	688	90.6	623	47.06	293	65	76
			Av.	**639**	**92.4**	**592**	**43.33**	**253**	**67**	**71**
6*b*	Mixed Minerals, as No. 6*a*,	480	1896	923	95.5	881	38.55	340	†	†
			1898	968	90.6	877	42.64	374	†	†
			1899	1118	92.9	1039	38.94	405	†	†
			Av.	**1003**	**93.0**	**932**	**40.04**	**373**	†	†

† The average of the yields on plots 6*a* and 6*b* is here taken at 100 for comparison.

SOIL TEST EXPERIMENTS.

In 1890 the Station began at Storrs, on the same field as that used for the special nitrogen experiments, a series of experiments known as "soil tests." The purpose was to study the deficiencies of soils and the particular needs of different crops for the different ingredients of fertilizers. The fertilizers used in these soil tests are, in general, of the same kinds of materials—dissolved bone-black, muriate of potash, and nitrate of soda—as those used in the special nitrogen experiments, and supply the phosphorus, potash, and nitrogen in the same combinations. In the special nitrogen experiments a uniform mixture of the mineral fertilizers—super-phosphate and potash salt—is used as a basis, and to this nitrogen is added in increasing proportions. In the soil test experiments the phosphoric acid, potash, and nitrogen are applied upon parallel plots of land first singly, then two by two, and finally all three together, as shown in the diagram on page 198.

For this series of soil test experiments a double group of plots was arranged as explained in the following paragraph, and upon these the experiments have been continued year by year, with the same plots and the same kinds and amounts of fertilizers on each indicated in the diagram below. The crops used in these experiments were grown in the following rotation, beginning with 1890: corn, potatoes, oats, cow peas, corn, potatoes, oats, soy beans, corn, potatoes. The experiments of 1897, 1898, and 1899, here reported, are the eighth, ninth, and tenth of this series, the crops grown in those years being respectively soy beans, corn, potatoes. The results of experiments previous to these are given in the annual Reports of the Station up to and including 1896.

The method of dividing the field into plots for these experiments, and the kinds of fertilizers and the amounts per acre used on each plot, are illustrated by the following diagram. The plots are laid out with the long dimension north and south. The field slopes gently to the south, but with not enough incline to cause serious washing and cutting of the surface by water. The soil of the field is a heavy loam, with a yellow clay loam subsoil. In 1888 and 1889, when the field was being cropped preparatory to being laid out for this series of experiments, it was noticed that the soil seemed to be poorer

toward the west side of the field. For this reason the field was divided into two sets of plots, each one-twenty-fourth acre in size, and the order of the plots in one of the two sets was reversed, as shown in the diagram. In considering the results of the experiments the data from both plots of the same number are combined and the results considered as if obtained from one plot one-twelfth acre in size. In this way errors due to the irregularities of the soil are partially eliminated.

Diagram illustrating the arrangement of the plots in the soil test, and the kinds of fertilizers and amounts per acre used on each plot.

Unfertilized strips separate the adjoining plots.

EAST.

PLOT o. Nothing.	PLOT Y. Stable manure, 16000 lbs.
PLOT A. Nit. of Soda, 160 lbs.	PLOT X. Stable man., 10000 lbs.; Dis. Bone-bl'k, 160 lbs.
PLOT B. Dis. Bone-bl'k, 320 lbs.	PLOT 000. Nothing.
PLOT C. Mur. of Pot., 160 lbs.	PLOT G. Dis. Bone-bl'k, 320 lbs.; Mur. of Pot., 160 lbs.; Nit. of Soda, 160 lbs.
PLOT 00. Nothing.	PLOT F. Dis. Bone-bl'k, 320 lbs.; Mur. of Pot., 160 lbs.
PLOT D. Dis. Bone-bl'k, 320 lbs.; Nit. of Soda, 160 lbs.	PLOT E. Mur. of Pot., 160 lbs.; Nit. of Soda, 160 lbs.
PLOT E. Mur. of Pot., 160 lbs.; Nit. of Soda, 160 lbs.	PLOT D. Dis. Bone-bl'k, 320 lbs.; Nit. of Soda, 160 lbs.
PLOT F. Dis. Bone-bl'k, 320 lbs.; Mur. of Pot., 160 lbs.	PLOT 00. Nothing.
PLOT G. Dis. Bone-bl'k, 320 lbs.; Mur. of Pot., 160 lbs.; Nit. of Soda, 160 lbs.	PLOT C. Mur. of Pot., 160 lbs.
PLOT 000. Nothing.	PLOT B. Dis. Bone-bl'k, 320 lbs.
PLOT X. Stable manure, 1000 lbs.; Dis. Bone-bl'k, 160 lbs.	PLOT A. Nit. of Soda, 160 lbs.
PLOT Y. Stable manure, 16000 lbs.	PLOT o. Nothing.

NORTH. SOUTH.

WEST.

In addition to the plots in the regular soil test, which include the plots from o to ooo inclusive in the above diagram, and are treated with the commercial fertilizers as explained, two other plots, X and Y, of the same size are included in the series, the former being treated with stable manure and phosphoric acid, and the latter with a larger quantity of stable manure, but without the addition of the mineral fertilizer.

Experiment of 1897.—From the rotation of crops given above it will be seen that soy beans were planted in 1897 following oats in 1896, instead of cow peas which had previously succeeded oats in the order of rotation. The results of the experiments with this crop are given in Table 47 below. The season was so wet, as before explained, that the field experiments were spoiled. The experiments for 1897, therefore, are not discussed.

TABLE 47.

SOIL TEST WITH FERTILIZERS ON SOY BEANS.

BY THE STATION, STORRS, 1897.

No. of Plot.	Fertilizers per Acre. Kind.	Weight.	Cost.	Yield per plot. 1-12 acre.	Yield per acre.		Gain over nothing plots.
		Lbs.	$	Lbs.	Lbs.	Bu.	Bu.
o	Nothing,	—	—	34.0	408	6.8	—
A	Nitrate of Soda,	160	3.50	31.0	372	6.2	−1.0
B	Dis. Bone-black,	320	2.92	35.5	426	7.1	−.1
C	Muriate of Potash,	160	3.69	31.9	383	6.4	−.8
oo	Nothing,	—	—	35.5	426	7.1	—
D	Nitrate of Soda,	160	6.42	44.8	538	9.0	1.8
	Dis. Bone-black,	320					
E	Nitrate of Soda,	160	7.19	37.9	455	7.6	.4
	Muriate of Potash,	160					
F	Dis. Bone-black,	320	6.61	46.7	560	9.3	2.1
	Muriate of Potash,	160					
G	Nitrate of Soda,	160	10.11	43.1	517	8.6	1.4
	Dis. Bone-black,	320					
	Muriate of Potash,	160					
ooo	Nothing,	—	—	38.5	462	7.7	—
X	Stable manure,	†10000	8.12*	57.3	688	11.5	4.3
	Dis. Bone-black,	160					
Y	Stable manure,	‡16000	10.68*	63.7	764	12.7	5.5

* The manure was valued at $3 per cord of 4,500 pounds. † Equivalent to 2.22 cords.
‡ Equivalent to 3.56 cords.

Experiments of 1898.—The soil test of 1898 was made with corn and seemed to be normal throughout, although the growing season of this year, while not so wet as that of 1897, was somewhat wetter than the average, owing to heavy rains in July and August. Quite a marked difference in the growth on

the different plots manifested itself throughout the season. In general the crops on the plots having no nitrogen in the fertilizer were pale yellow in color and more backward in growth than those on the plots with nitrogen. A comparison of the results from plot D with those from plots E and F, as given in Table 48 below, suggests that in this particular experiment the corn seemed to be benefited most by the combination of nitrogen and phosphoric acid in the fertilizer. The table shows, however, that the largest yields of corn in 1898 were obtained from plots X and Y, which had the stable manure with and without phosphoric acid. This is the third time that corn has come into the rotation of crops in this series of experiments; and, as will be seen by comparing the results for the three years, given in Table 50, in two of the three years the largest yield has been obtained from plot Y, with the largest amount of stable manure, while in the other year the yield from this plot was essentially the same as that from the plot G, with the mixed minerals and nitrogen.

Table 48.

SOIL TEST WITH FERTILIZERS ON WHITE FLINT CORN.

By the Station, Storrs, 1898.

No. of Plot.	Fertilizers per Acre.			Yield per Plot. 1-12 Acre.			Yield per Acre.			
	Kind.	Weight.	Cost.	Total ears.	Shelled corn.	Stover.	Shelled corn.	Shelled corn.	Stover.	Gain over not'g plots.
		Lbs.	$	Lbs.	Lbs.	Lbs	Lbs.	Bu.	Lbs.	Bu.
o	Nothing, - -	—	—	129.0	110.0	81	1320	23.6	972	—
A	Nit. of Soda, -	160	3.50	151.0	128.0	91	1536	27.4	1092	7.6
B	Dis. Bone-black,	320	2.39	147.5	128.0	95	1536	27.4	1140	7.6
C	Mur. of Potash, -	160	3.48	117.0	100.0	110	1200	21.4	1320	1.6
oo	Nothing, - -	—	—	94.0	78.5	72	942	16.8	864	—
D	Nit. of Soda, -	160	5.89	184.0	156.0	128	1872	33.4	1536	13.6
	Dis. Bone-black,	320								
E	Nit. of Soda, -	160	6.98	160.0	138.0	125	1656	29.6	1500	9.8
	Mur. of Potash, -	160								
F	Dis. Bone-black,	320	5.87	134.5	112.0	153	1344	24.0	1836	4.2
	Mur. of Potash, -	160								
G	Nit. of Soda, -	160	9.37	194.0	165.0	159	1980	35.4	1908	15.6
	Dis. Bone-black,	320								
	Mur. of Potash, -	160								
ooo	Nothing, - -	—	—	104.0	88.5	91	1062	19.0	1092	—
X	Stable manure, -	†10000	7.85*	216.5	188.0	155	2256	40.3	1860	20.5
	Dis. Bone-black,	160								
Y	Stable manure, -	‡16000	10.68*	235.0	201.0	185	2412	43.1	2220	23.3

* The manure was valued at $3 per cord of 4,500 pounds. † Equivalent to 2.22 cords.
‡ Equivalent to 3.56 cords.

Experiments of 1899.—Potatoes were grown in the soil tests of 1899. This is the third time this crop has been grown in this series of experiments. Two early varieties of potatoes were planted: "Fortune" on the set of plots on the north side of the field, and "Queen" on the set on the south side. In the early part of the season all the plants made a "full stand" and a fairly even growth; but, as the season advanced, quite striking differences were noticed in the growth on the different plots. Throughout the latter half of the season there was a healthier and more vigorous growth of plants on the plots upon which potash was applied. The beneficial effect of the potash upon this crop in this experiment is indicated by a comparison of the results from plots A, B, and C with each other, and also those from plots D, E, and F, as given in Table 49 below.

TABLE 49.

SOIL TEST WITH FERTILIZERS ON POTATOES.

BY THE STATION, STORRS, 1899.

No. of Plot.	Fertilizers per Acre.			Yield per Plot. 1-12 Acre.			Yield per Acre.			
	Kind.	Weight.	Cost.	Large.	Small.	Total.	Large.	Small.	Total.	Gain over not'g plots.
		Lbs.	$	Lbs.	Lbs.	Lbs.	Bu.	Bu.	Bu.	Bu.
o	Nothing, - -	—	—	121	149	270	24.2	29.8	54.0	—
A	Nit. of Soda, -	160	3.13	67	79	146	13.4	15.8	29.2	-6.8
B	Dis. Bone-black,	320	2.39	70	130	200	14.0	26.0	40.0	4.0
C	Mur. of Potash,	160	3.48	228	99	327	45.6	19.8	65.4	29.4
oo	Nothing, - -	—	—	52	77	129	10.4	15.4	25.8	—
D	Nit. of Soda, -	160	5.52	90	88	178	18.0	17.6	35.6	-.4
	Dis. Bone-black,	320								
E	Nit. of Soda, -	160	6.61	345	132	477	69.0	26.4	95.4	59.4
	Mur. of Potash,	160								
F	Dis. Bone-black,	320	5.87	311	171	482	62.2	34.2	96.4	58.4
	Mur. of Potash,	160								
G	Nit. of Soda, -	160	9.00	463	149	612	92.6	29.8	122.4	86.4
	Dis. Bone-black,	320								
	Mur. of Potash,	160								
ooo	Nothing, - -	—	—	56	85	141	11.2	17.0	28.2	—
X	Stable manure, -	†10000	7.85*	281	160	441	56.2	32.0	88.2	52.2
	Dis. Bone-black,	160								
Y	Stable manure, -	‡16000	10.68*	415	194	609	83.0	38.8	121.8	85.8

* The manure was valued at $3 per cord of 4,500 pounds. † Equivalent to 2.22 cords.
‡ Equivalent to 3.56 cords.

In each case the yield from the plots with potash was very much larger than from those without. The total yields per acre, however, and the proportion of merchantable tubers were largest from plot G, with the complete fertilizer, *i. e.*, nitrogen, phosphoric acid, and potash. It will be seen from Table 50 that for the three years in which this crop has been used in this series of experiments the largest yields have in all cases been obtained from plot G, although the yields have been nearly as large from plot Y, with the largest amount of stable manure.

The results of these experiments for the ten years in which the series has been thus far carried on, with the rotation of crops as stated, are summarized in the following table. They seem to indicate that there is no striking deficiency of any one of the ingredients—nitrogen, phosphoric acid, or potash—in this particular soil. The special requirements for fertilizers, as shown by the results from year to year, seem to be determined more largely by the needs of the particular crop than by the peculiarities of the soil. This fact is illustrated quite clearly by the figures in Table 50.

TABLE 50.

Yields in the Station soil test experiments for the past ten years.

Plot No.	Fertilizers.	Weight per acre.	Corn. 1890.	Potatoes. 1891.	Oats. 1892.	Cow peas (vines). 1893.	Corn. 1894.	Potatoes. 1895.	Oats. 1896.	Soy beans. 1897.	Corn. 1898.	Potatoes. 1899.
		Lbs.	Bu.	Bu.	Bu.	Lbs.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.
o	Nothing, -	—	28.9	89	29.1	10230	33.6	55	29.6	6.8	23.6	54.0
A	Nit. of Soda,	160	32.4	105	36.0	10960	41.0	50	39.0	6.2	27.4	29.2
B	Dis. Bn.-bl'k,	320	33.3	97	27.0	10710	37.6	56	34.9	7.1	27.4	40.0
C	Mur. of Pot.,	160	30.4	171	26.3	11680	40.8	88	27.8	6.4	21.4	65.4
oo	Nothing, -	—	26.7	87	24.2	9725	28.0	38	26.3	7.1	16.8	25.8
D	Nit. of Soda,	160	36.1	110	37.9	12920	40.8	57	48.0	9.0	33.4	35.6
	Dis. Bn.-bl'k,	320										
E	Nit. of Soda,	160	32.8	160	30.0	13335	47.6	104	41.3	7.6	29.6	95.4
	Mur. of Pot.,	160										
F	Dis. Bn.-bl'k,	320	34.4	214	27.8	15790	48.2	109	36.4	9.3	24.0	96.4
	Mur. of Pot.,	160										
G	Nit. of Soda,	160	37.4	259	39.4	16210	58.2	129	50.6	8.6	35.4	122.4
	Dis. Bn.-bl'k,	320										
	Mur. of Pot.,	160										
·ooo	Nothing, -	—	28.5	88	22.5	12100	38.0	49	29.3	7.7	19.0	28.2
X	Stable man.,	10000	44.1	210	40.9	15795	57.0	110	48.8	11.5	40.3	88.2
	Dis. Bn.-bl'k,	160										
Y	Stable man.,	16000	43.6	250	41.3	15875	56.7	125	55.1	12.7	43.1	121.8

SUMMARY AND GENERAL DEDUCTIONS.

The special nitrogen experiments here reported were made with corn, cow peas, and soy beans. The purpose of the experiments is twofold: First, to study the effects upon the yields of the crops when different kinds and quantities of nitrogenous fertilizers are used in addition to uniform quantities of mineral fertilizers; and second, to study the effect of the nitrogen in the fertilizers upon the proportion and amount of protein in the crops.

The experiments with corn seem to indicate that mineral fertilizers alone are of comparatively little value for increasing the yields of the crops, while nitrogenous fertilizers with the minerals greatly increase the yields. In considering the yields alone the nitrogenous fertilizers are most profitable on this crop when used in quantities sufficient to supply from twenty-five to fifty pounds of nitrogen per acre, in connection with liberal quantities of phosphoric acid and potash. But when the increased feeding value is also considered, as indicated by the percentages and total yields of protein per acre, even larger quantities of the nitrogenous fertilizers may sometimes prove economical. In these experiments in most cases the largest percentages of protein have been found, in both the corn and stover, from plots where the largest quantities of nitrogen have been used in the fertilizers.

*In contrast with corn, the experiments with legumes indicate that nitrogenous fertilizers increase the yield but very little over that which is obtained from the use of mineral fertilizers only. In the experiments with the cow pea fodder, the average of the results here reported shows essentially no advantage in the use of the nitrogenous fertilizers. The results of the experiments with soy beans grown for seed show some increase from the use of the nitrogenous fertilizers, but the increase was small. As regards the percentages and yields of protein in either cow peas or soy beans the results show very little increase accompanying the increase in the amount of nitrogen in the fertilizers. On the whole, therefore, the experiments appear to indicate that where an abundance of mineral fertilizers are available, nitrogen has very little effect in increasing either the total yield or feeding value of cow peas or soy beans.**

* A more complete discussion of the effects of nitrogenous fertilizers upon the yields and the composition of certain grasses, grains, and legumes will be found on pp. 113–203 of the Report of this Station for 1898.

From the results of the soil test experiments here reported it appears that, in the case of the soil upon which the experiment was made, the peculiarities of the crop grown in any particular experiment is of more importance than any deficiency of the soil in regulating the demand for fertilizers. During the ten years in which the experiments have been made on the field with a rotation of crops, the ingredient or ingredients that have been most essential have varied with the crop. When corn and oats were grown phosphoric acid and nitrogen appeared to be most essential, while the requirement of potatoes seemed to be potash.

In soil tests made for a number of years by the Station, in coöperation with farmers on farms in different parts of the State, the results in numerous instances have shown that deficiencies in the soil rather than the kind of crop have regulated the demands for fertilizers. Some soils are naturally lacking in some one of the essential ingredients of plant food, but are well supplied with the others; while other soils, like that in experiments at the Station, show no special deficiency in any one of the essential ingredients of plant food, but seem to be lacking in all of them. The particular importance of these results to the farmer is the indication of the need of studying and testing his own soil to learn its deficiencies and peculiar needs.

AN EXPERIMENT ON SOIL IMPROVEMENT.

BY C. S. PHELPS.

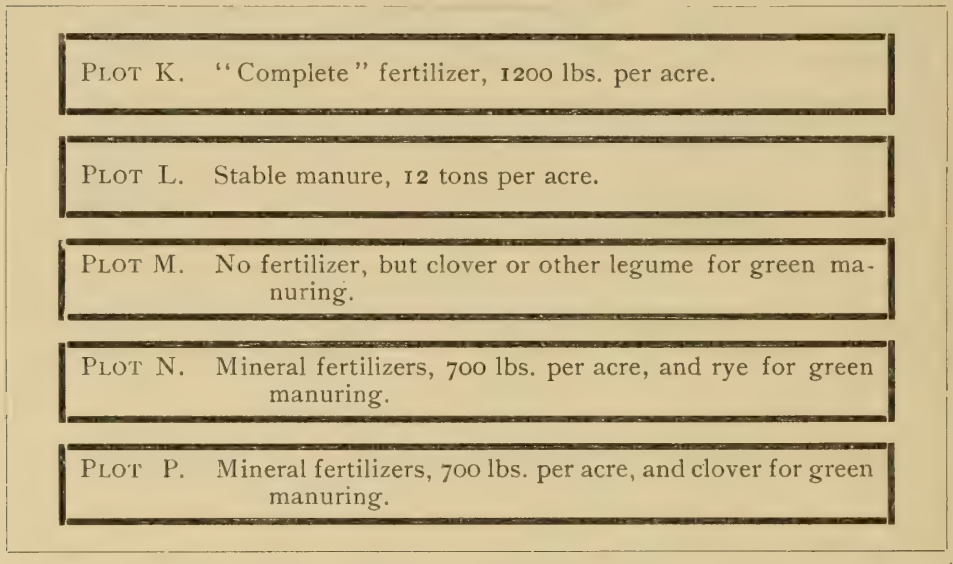
An experiment on soil improvement, which is to be continued through quite a period of years, was laid out by the Station on a series of plots of land at Storrs in the spring of 1899. An account of the preliminary experiment is here given. The soil on which the experiment is being carried out appears to be lacking in organic matter and probably in available nitrogen. Such a soil is commonly spoken of as "poor" or "worn out." The purpose of the experiment is to compare the value and economy of different methods of manuring for restoring fertility to a soil of this kind. The fertilizers used in the experiments, the kinds and quantities of which are fully explained in a later paragraph, are (1) stable manure, (2) a "complete" chemical fertilizer, and (3) "green" manures, both alone and in combination with mineral fertilizers. The plan of the experiments, which is given in detail beyond, consists briefly in applying the fertilizers of the different kinds and combinations upon the different plots, growing the same crop on all of the plots, and comparing the results in the yields of the crop.

The field selected for this experiment is one which had been used for a peach orchard since 1889. While the peach trees were growing the field had been liberally treated with mineral fertilizers, but not very much nitrogen had been supplied. During the years 1889 to 1894 different crops had been grown between the rows of trees and had been removed from the land; after 1894 the land remained under cultivation most of the time, but without cropping. Part of the peach trees were removed in the fall of 1897 and the balance in the fall of 1898. When the field was plowed in the spring of 1899 the soil, which is a medium heavy loam and holds moisture well, was compact and hard and seemed to be lacking in organic matter.

Plan of the experiment.—The arrangement of the plots on the experimental field, and the method of fertilizing each plot, are illustrated by the diagram below. The field is divided into five plots, each one-eighth acre in size, with strips 3.3 feet wide between them. In planting the field these strips between the plots, as well as similar strips at the sides and ends of the field, are planted the same as the plots, but no manure nor fertilizer of any kind is used on them, and the crop which grows on them is removed before that on the plots. In carrying out these experiments the same crop will be grown on the whole field in the same year, and the crops will vary from year to year in the following order of rotation: Corn, potatoes, oats and peas for fodder, and soy beans.

Diagram illustrating arrangement and method of fertilizing plots in experiment on soil improvement.

The narrow strips at the sides and ends of the plots are without fertilizer.



On plot K will be used a "complete" fertilizer, which will be composed of several of the various ingredients commonly used in different chemical fertilizers, in quantities sufficient to supply liberal amounts of phosphoric acid, potash, and nitrogen per acre. On plot L will be used good mixed stable manure at the rate of twelve tons per acre. On plot M no fertilizer will be used, but clover or some other legume, sown either in the spring with the crop, as with oats, or in the fall as a catch crop after the removal of the regular crop, will be allowed to

grow until the following spring and then turned under for green manuring. On plot N 700 pounds of mineral fertilizers, consisting of 200 pounds muriate of potash and 500 pounds South Carolina acid phosphate, will be used with the regular crop grown in the experiment, and rye will be sown for a catch crop in the fall and plowed under the following spring. On plot P the same kinds and amounts of mineral fertilizers will be used as on plot N, but clover or some other legume will be sown as a catch crop and plowed under in the spring. The same plots are to be fertilized in the same manner as here described year after year. An effort will be made each year to have the money value of the stable manure equal to that of the complete fertilizer. The values of both the complete fertilizer and the mineral fertilizers used will be determined according to the system of valuation adopted annually by the New England Experiment Stations; the value of the stable manure for the present will be considered as $3 per cord of 4,500 pounds.

In 1899 the ingredients of the complete fertilizer on plot K, and the rates per acre at which they were combined, were as follows: Nitrate of soda, 200 pounds; sulphate of ammonia, 100 pounds; tankage, 200 pounds; South Carolina acid phosphate, 500 pounds, making a total of 1,200 pounds of the mixture per acre. The stable manure on plot L was a mixture of horse and cattle manure, weighing 4,500 pounds to the cord, and was used at the rate of 12 tons or 5⅓ cords per acre. There was no fertilizer applied on plot M, and as no clover had been planted the preceding year there was none to plow under for green manuring in 1899. The next two plots, N and P, were fertilized with the minerals as indicated above, but, as in the case of plot M, no crops were ready to plow under until after the removal of the crop grown for experiment in 1899. On July 20, after the corn was well grown, alsike clover was sown on plots M and P at the rate of twenty-four pounds of seed per acre; rye was sown on plot N after the corn was harvested.

The yields from the different plots for the preliminary experiment of 1899 are given in Table 51. Inasmuch as the conditions of this experiment were such that no crops for green manuring could be grown so as to be of use as fertilizer for the first year's crop, the results are not discussed in this report.

TABLE 51.

Yields of corn and stover from the different plots in the preliminary experiment on soil improvement in 1899.

Plot No.	Fertilizers. Kind.	Weights per acre.	Cost per acre.	Yield per Plot. 1/8 Acre. Shelled corn. Good.	Shelled corn. Poor.	Stover.	Yield per Acre. Shelled corn. Good.	Shelled corn. Poor.	Stover.
		Lbs.	$	Lbs.	Lbs.	Lbs.	Bu.	Bu.	Lbs.
K	Complete fertilizer, - -	1200	16.94	495.0	24.6	1020	70.7	3.5	8160
L	Stable manure, - - -	24000	16.00	415.8	35.6	855	59.0	5.1	6840
M	No fertilizer, - - -	—	—	360.4	24.4	872	51.5	3.5	6976
N	Mineral fertilizer, - -	700	7.18	403.3	15.9	788	57.6	2.2	6304
P	Mineral fertilizer, - -	700	7.18	375.4	22.8	705	53.6	3.3	5640

ANALYSES OF FODDERS AND FEEDING STUFFS.

BY F. G. BENEDICT.

During the past year analyses have been made of over 200 food materials used in connection with metabolism and digestion experiments with men, and of about 120 samples of crops grown in field experiments with fertilizers. The methods of analysis were those recommended by the Association of Official Agricultural Chemists, with such minor modifications as have been found desirable.*

The descriptions and results of analyses of food materials used in the experiments with man will be published with other details of the investigations. The descriptions and results of the analyses of the samples of field crops are given on pages 211–218 of the present Report. The data of Table 52 show only the percentages of water, dry matter, nitrogen, and protein (N. × 6.25) in the fresh substance, and of nitrogen and protein (N. × 6.25) in the water-free material, as these suffice to indicate the proportions of nitrogen in the crop and also the effect of the nitrogenous fertilizers upon the proportions of protein in the plants. In previous Reports the complete analyses of both fresh and dry substances have been given, but the work of the Station has increased to such extent as to make it necessary to reduce the details to the minimum consistent with the purpose of the inquiry. It would have been interesting to determine the proportions of proteid and non-proteid nitrogen had the resources of the Station and the accuracy of the methods now in use been such as to warrant it. Tests for the presence of nitric acid were made in a considerable number of samples, especially those from the plots in which the largest quantities of nitrogen were applied in the fertilizers. In a few cases there were indications of minute quantities of nitric acid in the samples tested, but in most not even traces were detected.

* See Report of this Station for 1891.

For the sake of comparison of the results of these experiments with those given in former Reports, the protein in Table 52 is calculated by the usual method, as nitrogen multiplied by the factor 6.25, according to the assumption that protein contains sixteen per cent. of nitrogen. It has been repeatedly pointed out, however, that this factor is only approximately correct. This matter is discussed in some detail on page 76 of the present Report.

Two sets of averages are given in Table 52 beyond. The first are the averages of the analyses that are published for the first time in the present Report; the second are the averages of all analyses of similar materials made in this laboratory up to the present time.

DESCRIPTION OF SAMPLES.

All the analyses reported in the following table, excepting those of soy bean fodder (No. 6089), and silage corn (No. 6090), are those of crops grown in the plot experiments conducted by the Station for the purpose of studying the effects of different kinds and amounts of nitrogenous fertilizers upon the yield and composition of different crops. For convenience in describing the samples and the growth of the crop from which they were taken, it may be stated here* that all plots on the experimental field having the same number have the same kinds and amounts of fertilizers per acre. In the following descriptions of samples, therefore, the number of the plot will serve to indicate the fertilizer used in growing the crop, as shown by the scheme given here:

Plot No.	Kinds of Fertilizer Applied and Amounts per Acre.			
	Dissolved bone-black.	Muriate of potash.	Nitrate of soda.	Sulphate of ammonia.
	Lbs.	Lbs.	Lbs.	Lbs.
0, 00	—	—	—	—
6*a*, 6*b*	320	160	—	—
7	320	160	160	—
8	320	160	320	—
9	320	160	480	—
10	320	160	—	160
11	320	160	—	320
12	320	160	—	480

* For more complete description of the experiments see previous Reports of the Station, and also pages 168-204 of the present Report.

GRASSES AND GREEN FODDERS.

The following grasses were grown on plots in the Station grass garden during the year 1899. A large sample was taken from each of the plots, composed of small quantities of grass taken from several different parts of the plot, except from a strip next to other plots and next to paths. Care was taken to exclude from the sample all clover and all other grasses than the one to be analyzed. Each large sample was cut at once into pieces about one inch long, which were then thoroughly mixed. From this mass a smaller sample was taken, and, after being weighed, was dried in a steam drier especially constructed for such purpose.

Nos. 6071–6074. Brome grass (Bromus inermis).—Samples taken June 27, 1899, when in late bloom, some seed forming.

No. 6071 was from plot 0. Growth very light, thin, spindled, irregular, pale in color. Hardly sufficient grass on plot for a good sample. Some weeds and odd grasses on plot.

No. 6072 was from plot 6. Growth light, thin, slender, pale in color, slightly heavier than on plot 0. Some clover and odd grasses on plot.

No. 6073 was from plot 7. Growth medium heavy, good color, and fair proportion of bottom growth. (Not so good growth as that of fescue and orchard grass on corresponding plots.) Some weeds and odd grasses on plot.

No. 6074 was from plot 9. Growth heavy, dense, rich green in color, with fair proportion of bottom grass. (Not so heavy growth as that of fescue or orchard grass on corresponding plots.)

Nos. 6067–6070. Meadow fescue (Festuca elatior).—Samples were taken July 3, 1899, when the grass was in early seed stage.

No. 6067 was grown on plot 0. The growth was very thin, slender, pale in color, with practically no bottom growth. Only a little grass was left after the sample was cut. Some weeds and odd grasses grew on the plot.

No. 6068 was from plot 6. The growth was thin, light, pale in color, with practically no bottom growth. A little heavier than that on plot 0. Some weeds, clover, and odd grasses on the plot.

No. 6069 was from plot 7. The growth was much heavier than that on plot 6, of fair color, medium bottom growth. Some weeds and odd grasses on the plot.

No. 6070 was from plot 9. The growth was heavy, dense, of dark green color, with very heavy bottom growth. Some odd grasses on plot.

Nos. 6063–6066. Orchard grass (Dactylis glomerata).—Samples taken June 12, 1899, when a little past full bloom.

No. 6063 was from plot 0. The growth was thin and spindled, pale in color, with little bottom growth. There was a considerable mixture of weeds and other grasses and some clover on the plot.

No. 6064 was from plot 6. Growth thin and spindled, pale in color, little bottom growth. But little heavier growth than on plot 0. Considerable mixture of clover, with some weeds and other grasses.

No. 6065 was grown on plot 7. Growth fair, dark green color, much heavier than on plot 6, with considerable bottom growth. Some weeds and odd grasses on plot.

No. 6066 was grown on plot 9. Growth dense and heavy, about twice as heavy as on plot 7; dark green color, thick bottom growth. Some odd grasses on the plot.

Nos. 6075–6078. Timothy (Phleum pratense). Samples taken July 6, 1899, when the grass was in early seed stage.

No. 6075 was from plot 0. Growth very thin, light, and irregular; pale in color. Practically no bottom growth. Large proportion of weeds and odd grasses on plot.

No. 6076 was from plot 6. Growth very thin, light, and irregular; pale in color, with practically no bottom growth. Somewhat heavier than that on plot 0. Considerable clover and odd grasses.

No. 6077 was from plot 7. Growth medium heavy, fair color, little bottom growth. Some weeds and odd grasses on plot.

No. 6078 was from plot 9. Growth heavy, dense; rich green color; about twice as heavy as that on plot 7. Fair proportion of bottom growth. Some weeds and odd grasses on plot.

Of the following green fodders, Nos. 6079–6088 were grown as part of the special nitrogen experiments already mentioned, while Nos. 6089–6090 were grown especially for fodder. In each case a large sample, weighing from forty to fifty pounds, was taken by removing small quantities from different parts of the crop as it was being cut up in a silage cutter. Each large sample was thoroughly mixed, then a sub-sample was taken, weighed, and dried in the steam drier.

Nos. 6079–6088. Cow pea fodder.—Samples taken September 27, 1899.

Nos. 6079 and 6080 were from plots 0 and 00 respectively. The crop on these plots was very light; growth small and slender; the plants were drying up when harvested.

Nos. 6081 and 6082 were from plots 6*a* and 6*b* respectively. Growth quite heavy, succulent, with few seed pods; good color, and much the same growth as on nitrogen plots.

No. 6083 was from plot 7. Growth quite heavy, succulent, few seed pods.

No. 6084 was from plot 8. Growth fair, succulent, few seed pods. Crop not so heavy as on plot 7.

No. 6085 was from plot 9. Fair growth, succulent; not so heavy as on plot 7. Few seed pods.

No. 6086 was from plot 10. Growth quite heavy, succulent, few seed pods. Crop better than on plots 11 and 12.

No. 6087 was from plot 11. Growth medium heavy, succulent, few immature seed pods. Crop not so heavy as that on plot 9.

No. 6088 was from plot 12. Medium heavy growth, succulent, few immature seed pods. Crop not so heavy as on plot 9.

No. 6089. Soy bean fodder.*—Grown for silage, with mineral fertilizers only. Sample taken on September 25, 1899, from about a ton of the fodder which was being cut in silage cutter. There was a medium growth of fodder, which was quite well seeded when cut, but was still green and quite succulent.

No. 6090. Ensilage corn (Ohio white dent).* Sample taken on September 25, 1899, from eleven rows as weighed for test of yield. The corn (grain) was mostly in the "dough" stage, some of it just beginning to glaze. The stalks were green and succulent. About fifty pounds were taken for a large sample as the crop was being run through a silage cutter; this was mixed and sub-sampled.

* The complete analyses of these two samples were made. The composition of each, in the water-free substance and calculated to water content at time of taking sample, is shown in the table on the following page.

Complete analyses of samples Nos. 6089 and 6090.

Lab. No.	Feeding Stuffs.	Water.	Protein.	Fat.	Nit.-free ext.	Fiber.	Ash.	Fuel value per Lb.
	In Water-free Substance.	%	%	%	%	%	%	Cal.
6089	Soy bean fodder, -	—	17.56	8.57	40.05	28.75	8.07	1965
6090	Ensilage corn, -	—	7.84	4.95	61.00	21.24	4.97	1885
	In Fresh Substance.							
6089	Soy bean fodder, -	74.86	4.42	2.15	10.07	6.47	2.03	480
6090	Ensilage corn, -	74.00	2.04	1.29	15.86	5.52	1.29	490

CURED FODDERS.

Of the following cured fodders Nos. 6022–6031 and Nos. 6033–6042 were from the special nitrogen experiments of 1898, and Nos. 6091–6110 were from the same experiments of 1899. The samples of stover were taken just after the corn was husked and the stover was weighed. In 1898 a large sample of stover was taken from each plot by gathering small quantities from different parts of the total crop on the plot. These were cut into pieces one to two inches long, which were then thoroughly mixed, and from different parts of the whole mass a smaller sub-sample was taken, which was weighed and dried in the steam drier. In 1899 the entire crop of stover on each plot was cut into small pieces and mixed, and from this a sub-sample was taken.

Nos. 6022–6031, 6033–6042. Stover of white flint corn.—Grown in 1898. Nos. 6022–6031 were from plots on the north side of the field, on which lime was applied in addition to the regular fertilizers. Nos. 6033–6042 were from plots on the south side of the field on which the fertilizers were applied without the lime. The dates of taking the samples were as follows: Nos. 6034, 6035, 6036, 6040 on November 11; Nos. 6033, 6037, 6041 on November 14; Nos. 6022, 6030, 6031, 6038, 6039 on November 16; and Nos. 6023 to 6029, inclusive, on November 17.

Nos. 6022 and 6023 were from plots 00 and 0. The growth on plot 0 was small, spindled, pale in color, with few ears; mostly "poor" or unmerchantable corn. On plot 00 the stalks were small and slender, ears small, corn mostly poor or unmerchantable.

Nos. 6024 and 6025 were from plots 6*a* and 6*b*. Stalks were small and slender, pale in color; small proportion of merchantable ears.

No. 6026 was from plot 7. Growth better than on plot 6; stalks medium in size, color fair, ears and total crop rather light.

No. 6027 was from plot 8. Growth and color of stalks fair, with fair proportion of ears; better crop than on plot 7.

No. 6028 was from plot 9. Growth of stalks quite heavy and of good color. Fair growth of ears.

No. 6029 was from plot 10. Fair sized stalks of good color; fair proportion of good or merchantable ears. Growth was considerably better than that on plot 7, and much better than that on corresponding plot on south end of field.

No. 6030 was from plot 11. Growth on the whole much like that on plot 10; much better than that on corresponding plot on south end of field.

No. 6031 was from plot 12. Stalks rather small and slightly pale in color. Growth not so heavy as on plots 10 and 11, but much better than that on corresponding plot on south end of field.

Nos. 6033 and 6034 were from plots o and oo respectively. The growth on plot o was small and spindling, pale in color, and with few ears. The growth on plot oo was somewhat better, but stalks and ears were small. The ears in both crops were mostly "poor," or unmerchantable. There were many immature or partially developed kernels on the ears.

Nos. 6035 and 6036 were from plots 6*a* and 6*b* respectively. The growth on plot 6*a* was small, spindled, pale in color, but better than on plot o, with not many merchantable ears. The growth on plot 6*b* was similar, with a little better color, and ears slightly better. The proportion of merchantable ears was small.

No. 6037 was from plot 7. The growth on this plot was rather small, of fair color, with small proportion of ears. Many hills were missing.

No. 6038 was from plot 8. The growth on this plot was better than that on plot 7, of fair color, and fair proportion of ears. Many hills missing.

No. 6039 was from plot 9. The stover moulded a little when curing. The growth on this plot was heavier than that on plot 8; the color was good, ears fair.

No. 6040 was from plot 10. The growth on this plot was heavier than that on plot 7; good color, fair growth of ears.

No. 6041 was from plot 11. The growth was much the same as on plot 8. Color good and fair growth of ears.

No. 6042 was from plot 12. The growth was much the same as that on plot 9; good color, but paler than that on plot 11; fairly heavy, and good growth of ears. Some hills missing.

Nos. 6091–6110. Stover of white flint corn.—Grown in 1899. Nos. 6091 to 6100 were from plots on the north side of the field, on which lime was applied in addition to the regular fertilizers. These were sampled on October 18, 1899. Nos. 6101 to 6110 were from plots on the south side of the field, without the addition of lime. These were sampled October 20, 1899.

Nos. 6091 and 6092 were from plots o and oo respectively. The stalks were very slender, the ears few and small.

Nos. 6093 and 6094 were from plots 6*a* and 6*b* respectively. The stalks were medium heavy, but pale in color; the proportion of ears was small.

No. 6095 was from plot 7. Fair growth of stalks and ears; stalks of good color.

No. 6096 was from plot 8. Good growth of stalks and ears; stalks of good color.

No. 6097 was from plot 9. Growth like that on plot 8.

No. 6098 was from plot 10. Growth much the same as on plot 7.

No. 6099 was from plot 11. Growth much the same as on plot 8.

No. 6100 was from plot 12. Growth better than that on plot 9.

Nos. 6101 and 6102 were from plots o and oo respectively. Stalks small and slender; ears very few and small.

Nos. 6103 and 6104 were from plots 6*a* and 6*b* respectively. Fair growth of stalks, pale in color. Small proportion of ears.

No. 6105 was from plot 7. Fair growth of stalks and ears. Stover rather slender, fair in color.

No. 6106 was from plot 8. Fair growth of stalks and ears, dark green stover; crop nearly as good as on plot 9.

No. 6107 was from plot 9. Fair growth of stalks and ears; stover dark green.

No. 6108 was from plot 10. Light growth of stalks and ears, about the same as on plot 7.

No. 6109 was from plot 11. Growth light; not equal to that on plot 8, but better than that on plot 12.

No. 6110 was from plot 12. Growth light, not so good as that on plot 9.

SEEDS.

Nos. 6111–6120. Soy bean seed.—Grown in 1899. Samples of about a quart each were taken December 28, 1899, after the weighing of the total crop of seeds from each plot was made.

Nos. 6111 and 6112 were from plots 0 and 00 respectively. Growth light, plants very small, seed fairly good.

Nos. 6113 and 6114 were from plots 6*a* and 6*b* respectively. On both plots the seeds were well matured. The growth on 6*a* was medium heavy; that on 6*b* was nearly equal to that on the best nitrogen plots.

No. 6115 was from plot 7. Seed well matured, medium growth; much the same as on plot 10.

Nos. 6015 and 6016 were from plots 8 and 9 respectively. The growth on these two plots was about alike, quite heavy, with seed well matured.

No. 6118 was from plot 10. Growth much the same as on plot 7.

No. 6119 was from plot 11. Growth not quite so heavy as that on plot 8.

No. 6120 was from plot 12. Growth not so heavy as on plot 9.

Nos. 6043–6062. White flint corn (Grain).—Grown in 1898. Nos. 6043 to 6052 were from plots on the south side of the field, Nos. 6053 to 6062 from plots on the north side. The entire growth of corn (ears) from each plot was dried in the Station barn from the time of husking until February 18, 1899; it was then shelled and dried farther until March 17, the date of sampling. At this date the corn was weighed, and from each crop a sample of two quarts was taken, from which about one quart of "good" kernels was selected for a final sample, which was then sealed in a tight jar. For description of the growth on the different plots see description of the corresponding samples of stover, Nos. 6022–6031, 6033–6042.

Nos. 6140–6159. White flint corn (Grain).—Grown in 1899, sampled January 15, 1900. A sample of about three pints was taken from the total amount of "good" corn from each plot at the time of weighing the yields from the plot. The chaff and immature corn was picked out and discarded, and the sample sealed in a quart jar. Nos. 6140 to 6149 were from plots on the south side of the field; Nos. 6150–6159 from plots on the north side. For description of the growth on the different plots see description of the corresponding samples of stover, Nos. 6091–6110.

TABLE 52.

Composition of samples of field crops grown with different fertilizers.

[Averages of analyses here given together with those of former years.]

Lab. No.	MATERIAL.	IN WATER-FREE SUBSTANCE.		IN FRESH SUBSTANCE.			
		Nitrogen.	Protein. N.×6.25.	Water.	Dry matter.	Nitrogen.	Protein. N.×6.25.
		%	%	%	%	%	%
6071	Bromus inermis, - -	1.09	6.81	62.3	37.7	.4	2.6
6072	Bromus inermis, - -	1.17	7.31	64.8	35.2	.4	2.6
6073	Bromus inermis, - -	1.24	7.75	66.8	33.2	.4	2.6
6074	Bromus inermis, - -	1.23	7.69	70.4	29.6	.4	2.3
	Average (4), - - -	**1.18**	**7.39**	**66.1**	**33.9**	**.4**	**2.5**
	Average all analyses (12),	**1.41**	**8.79**	**65.8**	**34.2**	**.5**	**3.1**
6067	Meadow fescue, - -	1.01	6.31	65.6	34.4	.4	2.2
6068	Meadow fescue, - -	.99	6.19	68.5	31.5	.3	1.9
6069	Meadow fescue, - -	1.24	7.75	69.9	30.1	.4	2.3
6070	Meadow fescue, - -	1.58	9.88	73.6	26.4	.4	2.6
	Average (4), - - -	**1.21**	**7.53**	**69.4**	**30.6**	**.4**	**2.3**
	Average all analyses (26),	**1.36**	**8.50**	**69.8**	**30.2**	**.4**	**2.5**
6063	Orchard grass, - - -	1.24	7.75	70.8	29.2	.4	2.3
6064	Orchard grass, - - -	1.22	7.63	71.9	28.1	.3	2.1
6065	Orchard grass, - - -	1.21	7.56	75.3	24.7	.3	1.9
6066	Orchard grass, - - -	1.81	11.31	76.5	23.5	.4	2.6
	Average (4), - - -	**1.37**	**8.56**	**73.6**	**26.4**	**.4**	**2.2**
	Average all analyses (28),	**1.48**	**9.23**	**69.5**	**30.5**	**.4**	**2.8**
6075	Timothy, - - - -	1.09	6.81	57.5	42.5	.5	2.9
6076	Timothy, - - - -	1.04	6.50	59.5	40.5	.4	2.6
6077	Timothy, - - - -	.98	6.12	62.0	38.0	.4	2.3
6078	Timothy, - - - -	1.14	7.12	63.1	36.9	.4	2.6
	Average (4), - - -	**1.06**	**6.64**	**60.5**	**39.5**	**.4**	**2.6**
	Average all analyses (28),	**1.23**	**7.66**	**65.7**	**34.3**	**.4**	**2.6**
6079	Cow pea fodder, - -	3.33	20.81	83.7	16.3	.5	3.4
6080	Cow pea fodder, - -	3.73	23.31	83.8	16.2	.6	3.8
6081	Cow pea fodder, - -	3.38	21.12	85.0	15.0	.5	3.2
6082	Cow pea fodder, - -	3.23	20.19	85.3	14.7	.5	2.9
6083	Cow pea fodder, - -	3.37	21.06	85.2	14.8	.5	3.1
6084	Cow pea fodder, - -	3.15	19.69	84.8	15.2	.5	3.0
6085	Cow pea fodder, - -	3.67	22.94	85.2	14.8	.5	3.4
6086	Cow pea fodder, - -	3.21	20.07	84.3	15.7	.5	3.1
6087	Cow pea fodder, - -	3.34	20.88	84.7	15.3	.5	3.2
6088	Cow pea fodder, - -	3.67	22.94	85.8	14.2	.5	3.3
	Average (10), - -	**3.41**	**21.30**	**84.8**	**15.2**	**.5**	**3.2**
	Average all analyses (77),	**2.97**	**18.54**	**83.1**	**16.9**	**.5**	**3.1**
6089	Soy bean fodder,* - -	2.81	17.56	74.9	25.1	.7	4.4
	Average all analyses (17),	**2.51**	**15.67**	**76.2**	**23.8**	**.6**	**3.7**
6022	Corn stover, - - -	1.33	8.31	30.1	69.9	.9	5.8
6023	Corn stover, - - -	.93	5.81	23.6	76.4	.7	4.4

* For complete analysis of this sample see p. 213.

TABLE 52.—*(Continued.)*

Lab. No.	Material.	In Water-free Substance.		In Fresh Substance.			
		Nitrogen.	Protein. N. × 6.25.	Water.	Dry matter.	Nitrogen.	Protein. N. × 6.25.
		%	%	%	%	%	%
6024	Corn stover,	.86	5.37	29.1	70.9	.6	3.8
6025	Corn stover,	.78	4.88	28.8	71.2	.6	3.5
6026	Corn stover,	.83	5.19	27.1	72.9	.6	3.8
6027	Corn stover,	.89	5.56	26.4	73.6	.7	4.1
6028	Corn stover,	1.06	6.62	36.4	63.6	.7	4.2
6029	Corn stover,	.75	4.69	26.7	73.3	.6	3.4
6030	Corn stover,	.81	5.06	33.1	66.9	.5	3.4
6031	Corn stover,	.89	5.56	39.1	60.9	.5	3.4
6033	Corn stover,	1.25	7.81	31.4	68.6	.9	5.4
6034	Corn stover,	1.45	9.06	38.0	62.0	.9	5.6
6035	Corn stover,	1.09	6.81	37.2	62.8	.7	4.3
6036	Corn stover,	1.04	6.50	31.8	68.2	.7	4.4
6037	Corn stover,	1.00	6.25	35.7	64.3	.6	4.0
6038	Corn stover,	.91	5.69	29.7	70.3	.6	4.0
6039	Corn stover,	1.00	6.25	42.0	58.0	.6	3.6
6040	Corn stover,	.93	5.81	33.6	66.4	.6	3.9
6041	Corn stover,	.97	6.06	42.4	57.6	.6	3.5
6042	Corn stover,	1.09	6.81	38.4	61.6	.7	4.2
6091	Corn stover,	1.44	9.00	31.7	68.3	1.0	6.1
6092	Corn stover,	1.86	11.63	31.9	68.1	1.3	7.9
6093	Corn stover,	1.06	6.62	42.1	57.9	.6	3.8
6094	Corn stover,	.93	5.81	41.3	58.7	.5	3.2
6095	Corn stover,	.99	6.19	42.8	57.2	.6	3.6
6096	Corn stover,	1.20	7.50	37.3	62.7	.8	4.7
6097	Corn stover,	1.15	7.19	43.5	56.5	.7	4.1
6098	Corn stover,	1.25	7.81	39.3	60.7	.8	4.8
6099	Corn stover,	1.27	7.94	45.0	55.0	.7	4.4
6100	Corn stover,	1.31	8.19	49.6	50.4	.7	4.1
6101	Corn stover,	1.37	8.56	27.3	72.7	1.0	6.3
6102	Corn stover,	1.66	10.37	28.1	71.9	1.2	7.5
6103	Corn stover,	1.20	7.50	35.7	64.3	.8	4.8
6104	Corn stover,	.97	6.06	32.4	67.6	.7	4.1
6105	Corn stover,	1.50	8.12	38.8	61.2	.8	4.9
6106	Corn stover,	1.39	8.69	30.1	69.9	1.0	6.1
6107	Corn stover,	1.81	11.31	38.8	61.2	1.1	6.9
6108	Corn stover,	1.18	7.38	34.8	65.2	.8	4.8
6109	Corn stover,	2.03	12.69	34.2	65.8	1.3	8.4
6110	Corn stover,	2.36	14.75	36.4	63.6	1.5	9.4
	Average (40),	**1.19**	**7.44**	**35.0**	**65.0**	**.8**	**4.8**
	Average all analyses (220),	**1.05**	**6.58**	**39.8**	**60.2**	**.6**	**3.9**
6090	Ensilage corn,*	1.26	7.84	74.0	26.0	.3	2.0
	Average all analyses (2),	**1.35**	**8.42**	**73.1**	**26.9**	**.4**	**2.3**
6111	Soy beans,	6.80	42.50	9.2	90.8	6.2	38.6
6112	Soy beans,	7.53	47.06	9.4	90.6	6.8	42.6
6113	Soy beans,	6.65	41.57	7.8	92.2	6.1	38.3
6114	Soy beans,	6.23	38.94	7.1	92.9	5.8	36.2
6115	Soy beans,	6.49	40.57	8.2	91.8	6.0	37.3
6116	Soy beans,	6.41	40.06	7.4	92.6	5.9	40.1

* For complete analysis of this sample see p. 213.

TABLE 52.—*(Continued.)*

Lab. No.	Material.	In Water-free Substance.		In Fresh Substance.			
		Nitrogen.	Protein. N.×6.25.	Water.	Dry matter.	Nitrogen.	Protein. N.×6.25.
		%	%	%	%	%	%
6117	Soy beans,	6.61	41.31	8.3	91.7	6.1	37.9
6118	Soy beans,	6.55	40.94	8.8	91.2	6.0	37.4
6119	Soy beans,	6.54	40.88	8.4	91.6	6.0	37.4
6120	Soy beans,	6.92	43.25	8.3	91.7	6.3	39.6
	Average (10),	**6.67**	**41.71**	**8.3**	**91.7**	**6.1**	**38.5**
	Average all analyses (45),	**6.18**	**38.64**	**8.3**	**91.7**	**5.9**	**37.1**
6043	White flint corn,	1.71	10.69	11.8	88.2	1.5	9.4
6044	White flint corn,	1.74	10.88	15.1	84.9	1.5	9.3
6045	White flint corn,	1.56	9.75	13.4	86.6	1.4	8.4
6046	White flint corn,	1.57	9.81	14.7	85.3	1.3	8.4
6047	White flint corn,	1.68	10.50	14.4	85.6	1.4	9.0
6048	White flint corn,	1.66	10.38	13.9	86.1	1.4	8.9
6049	White flint corn,	1.83	11.44	15.1	84.9	1.6	9.7
6050	White flint corn,	1.69	10.56	15.6	84.4	1.4	8.9
6051	White flint corn,	1.69	10.56	16.4	83.6	1.4	8.8
6052	White flint corn,	1.73	10.81	15.5	84.5	1.5	9.1
6053	White flint corn,	1.57	9.81	15.7	84.3	1.3	8.3
6054	White flint corn,	1.70	10.62	16.8	83.2	1.4	8.8
6055	White flint corn,	1.55	9.69	15.0	85.0	1.3	8.3
6056	White flint corn,	1.55	9.69	14.5	85.5	1.3	8.3
6057	White flint corn,	1.66	10.37	18.5	81.5	1.4	8.4
6058	White flint corn,	1.61	10.07	15.4	84.6	1.4	8.5
6059	White flint corn,	1.70	10.62	16.9	83.1	1.4	8.8
6060	White flint corn,	1.62	10.12	16.6	83.4	1.4	8.4
6061	White flint corn,	1.60	10.00	14.2	85.8	1.4	8.6
6062	White flint corn,	1.67	10.44	14.9	85.1	1.4	8.9
6140	White flint corn,	1.79	11.19	11.7	88.3	1.6	9.9
6141	White flint corn,	1.79	11.19	12.7	87.3	1.6	9.8
6142	White flint corn,	1.46	9.13	12.9	87.1	1.3	7.9
6143	White flint corn,	1.53	9.56	12.8	87.2	1.3	8.3
6144	White flint corn,	1.60	10.00	11.2	88.8	1.4	8.9
6145	White flint corn,	1.60	10.00	11.3	88.7	1.4	8.9
6146	White flint corn,	1.78	11.12	13.6	86.4	1.5	9.6
6147	White flint corn,	1.61	10.06	11.3	88.7	1.4	8.9
6148	White flint corn,	1.70	10.63	11.9	88.1	1.5	9.4
6149	White flint corn,	1.73	10.81	13.8	86.2	1.5	9.3
6150	White flint corn,	1.63	10.19	10.3	89.7	1.5	9.1
6151	White flint corn,	1.79	11.19	10.4	89.6	1.6	10.0
6152	White flint corn,	1.65	10.31	12.6	87.4	1.4	9.0
6153	White flint corn,	1.58	9.87	11.5	88.5	1.4	8.8
6154	White flint corn,	1.65	10.31	11.1	88.9	1.5	9.2
6155	White flint corn,	1.75	10.94	13.5	86.5	1.5	9.4
6156	White flint corn,	1.82	11.37	12.7	87.3	1.6	9.9
6157	White flint corn,	1.85	11.56	14.6	85.4	1.6	9.9
6158	White flint corn,	1.86	11.63	14.5	85.5	1.6	9.9
6159	White flint corn,	1.84	11.50	13.8	86.2	1.6	9.9
	Average (40),	**1.68**	**10.48**	**13.8**	**86.2**	**1.4**	**9.0**
	Average all analyses (213),	**1.83**	**11.44**	**18.0**	**82.0**	**1.4**	**9.0**

METEOROLOGICAL OBSERVATIONS.

REPORTED BY C. S. PHELPS.

The meteorological observations made under the directions of the Station during 1899 were similar to those of previous years. The Station equipment at Storrs consists of the ordinary instruments for observing temperatures, pressure of the air, humidity, rainfall, snowfall, and velocity of the wind, similar to those in use by the Weather Service of the United States Department of Agriculture. In addition to the records made at Storrs, the rainfall for the summer season (May 1 to October 31) has been recorded by ten farmers in different parts of the State in coöperation with the Station.

The total precipitation for the year (38.3 inches) was 6.8 inches below the average at Storrs for the past eleven years, and about 10 inches below the general average for Connecticut, as computed from the records of the New England Meteorological Society's observers, who have made observations covering periods of from five to thirty years. The rainfall was especially deficient for April and May, and for June up to the middle of the month. The deficiency in the rainfall during this period greatly reduced the yield of hay so that the crop was one of the lightest for many years. The rainfall for the balance of the growing season was ample and most other crops gave normal yields.

The average temperature for February was unusually low, while for March and April it was about normal. The spring opened favorably for farm work and most crops were planted earlier than usual. The last killing frost in the spring occurred May 4. The temperature for June was somewhat above the normal, but for the balance of the summer it was about the average. The growing season was shorter than usual, light frosts occurring September 7 and 14, and quite severe frosts September 15 and 16. The growing season from the time of the last severe frost in the spring to that of the first in the fall was only 134 days, while the average growing season at Storrs

for the past twelve years has been 146 days. An unusually severe freeze occurred October 2, and another October 3, small pools of water being frozen over one-third of an inch in thickness and potatoes which were not harvested were considerably frozen.

With the exception of the severe freeze just referred to the fall months were mild and very favorable for the harvesting of crops. The first snow occurred November 14, but remained on the ground only a few days, and the fields were bare most of the time until the close of the year.

Through the kindness of the New England Meteorological Society we are able to publish the rainfall records from ten of their stations in Connecticut. Table 53 gives the rainfall as recorded for the six months ending October 31 for twenty-one localities in the State, and Table 54 gives the summary of observations made by the Station at Storrs.

TABLE 53.

Rainfall during six months ending October 31, 1899.

LOCALITY.	OBSERVER.	INCHES PER MONTH.						
		May.	June.	July.	August.	September.	October.	Total.
Canton,	G. J. Case,	2.09	6.44	6.83	3.00	4.83	2.50	25.69
Clark's Falls,	E. D. Chapman,	2.30	2.74	5.00	2.96	2.93	1.87	17.80
Colchester,	S. P. Willard,	2.11	2.82	5.38	4.21	3.47	1.21	19.20
Cream Hill,	C. L. Gold,	1.75	3.39	6.70	1.11	4.21	1.67	18.83
Falls Village,	M. H. Dean,	2.68	3.99	7.09	.88	4.82	1.63	21.09
Gilead,	A. C. Gilbert,	1.71	3.49	4.30	3.37	3.53	2.00	18.40
Hartford,	Prof. S. Hart,	1.71	3.07	6.23	1.92	3.60	2.98	19.51
Lebanon,	E. A. Hoxie,	3.10	3.58	5.43	4.58	6.29	2.25	25.23
Madison,	J. D. Kelsey,	2.69	2.58	5.10	.55	3.24	1.51	15.67
New Haven,	Weather Bureau,	2.52	2.59	4.17	.65	3.33	1.78	15.04
Newington,	J. S. Kirkham,	1.41	1.88	6.99	1.35	3.27	2.43	17.33
New London,	Weather Bureau,	2.52	2.60	5.29	2.59	4.32	1.87	19.19
North Franklin,	C. H. Lathrop,	1.84	3.57	4.82	4.12	5.25	2.30	21.90
Norwalk,	G. S. Comstock,	2.05	3.06	5.91	.37	4.80	1.42	17.61
Southington,	Lumen Andrews,	1.75	2.23	5.62	.45	4.13	2.35	16.53
South Manchester,	K. B. Loomis,	2.22	2.21	4.73	1.36	3.02	2.66	16.20
Storrs,	Experiment Station,	1.27	3.72	5.55	3.27	3.31	1.54	18.66
Voluntown,	Rev. C. Dewhurst,	1.52	2.59	4.58	2.22	8.41	1.43	20.75
Waterbury,	N. J. Welton,	2.07	2.32	6.02	1.03	5.30	2.42	19.16
West Simsbury,	S. T. Stockwell,	2.04	6.71	6.60	3.79	4.29	1.87	25.30
Winchester,	W. L. Wetmore,	1.66	2.62	6.19	1.44	3.37	1.67	16.95
	Average,	**2.05**	**3.25**	**5.64**	**2.15**	**4.27**	**1.97**	**19.34**

TABLE 54.

Meteorological Summary for 1899.

OBSERVATIONS MADE AT STORRS BY THE STATION.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Mean.	Total.
Highest barometer,	30.90	30.54	30.54	30.36	30.33	30.26	30.26	30.35	30.49	30.49	30.49	30.79	30.49	—
Lowest barometer,	29.39	29.18	29.39	29.53	29.73	29.75	29.72	29.80	29.65	29.77	29.46	29.28	29.55	—
Mean barometer,	30.17	30.01	30.09	30.07	30.05	30.03	29.98	30.02	30.07	30.21	30.00	30.11	30.07	—
Highest temperature,	50	51	58	78	84	92	86	86	80	79	62	61	72	—
Lowest temperature,	−11	−10	13	21	33	45	46	45	35	25	19	—	22	—
Mean temperature,	25	22	31	45	56	67	68	67	59	52	39	31	47	—
Relative humidity,	—	—	—	61	64	71	75	75	77	78	—	—	—	—
Total precipitation,	3.76	3.97	5.58	2.20	1.17	3.72	5.55	3.27	3.31	1.54	2.10	2.14	—	38.31
Number of days with precipitation of .01 inch or more,	10	8	11	6	8	9	10	4	8	7	4	8	—	93
Number of clear days,	11	11	6	18	14	11	12	11	12	7	8	11	—	132
Number of fair days,	11	6	13	10	8	13	9	11	9	13	13	15	—	131
Number of cloudy days,	9	11	12	2	9	6	10	9	9	11	9	5	—	102
Total movement of wind in miles,	7466	7091	8826	7326	5932	5227	5543	3170	5184	4635	5736	5940	—	—
Maximum velocity of wind,	48	48	55	48	32	32	26	30	36	36	40	38	—	—

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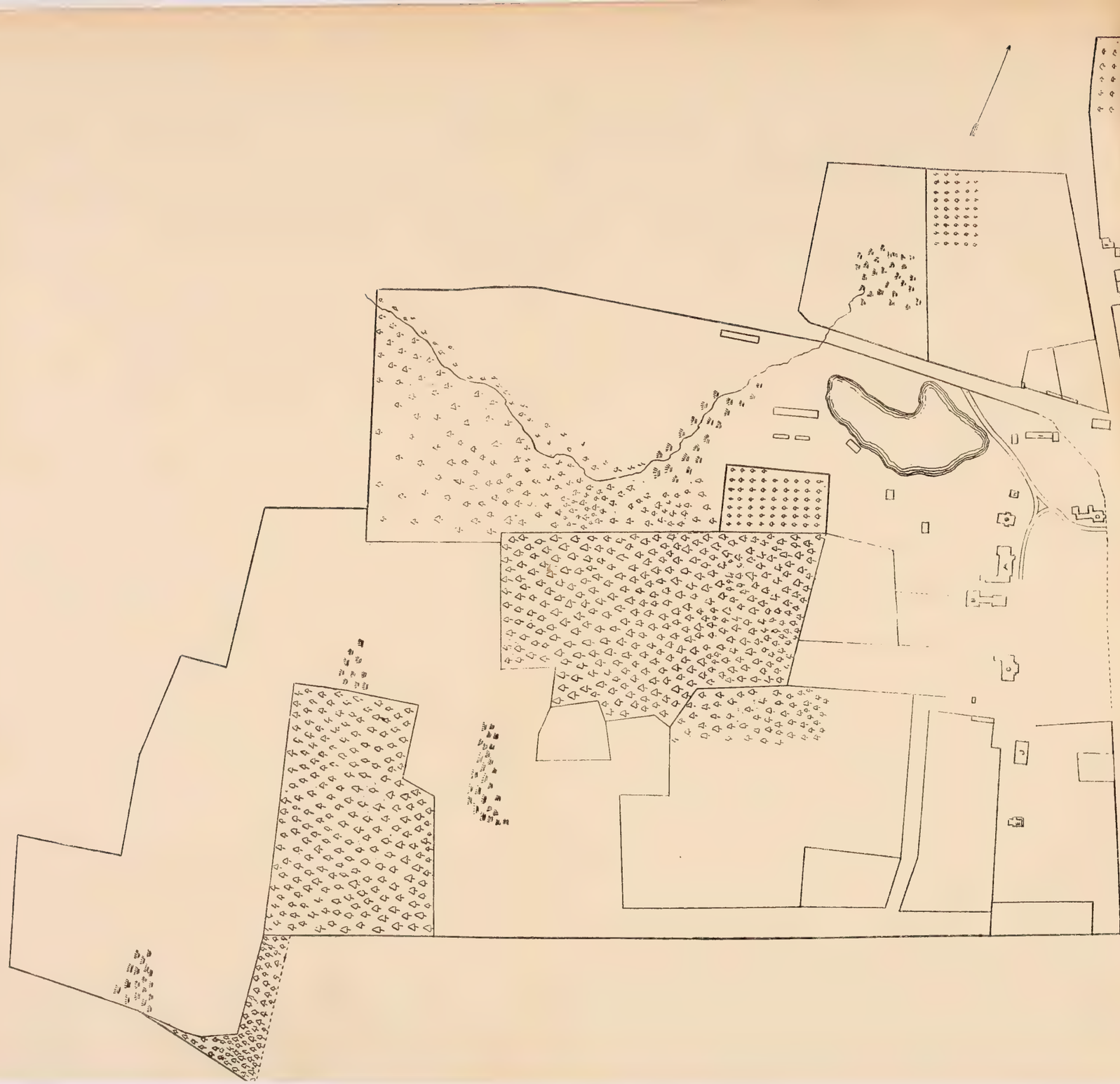
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PUBLICATIONS OF THE STATION.

The publications of the Station will be mailed to all citizens of Connecticut, and to Granges, Farmers' Clubs, and other agricultural organizations, who ask for them, and so far as circumstances permit, to those who apply from other States.

Requests for publications should be addressed to

STORRS AGRICULTURAL
EXPERIMENT STATION,
TOLLAND COUNTY. - STORRS, CONN.



FARM OF CONNECTICUT AGRICULTURAL COLLEGE

STORRS CONN

1897

A. Main Building
B. Boys Dormitory
C. Girls Cottage
D. Old Dormitory
E. Cottage No. 1.
F. Farm House
G. Chemical Laboratory
H. Experiment Sta. Office
I. Green House
J. Horse Barn
K. Cattle Barn
L. Dairy

ANNUAL REPORT

OF THE

TRUSTEES

OF THE

CONNECTICUT AGRICULTURAL COLLEGE

AT

MANSFIELD, CONN.

(P. O. STORRS, CONN.)

For the period embraced within the first day of December, 1898, and November 30, 1899.

PART I.

"When tillage begins, other arts follow. The farmers therefore are the founders of human civilization."— WEBSTER.

PRINTED BY ORDER OF THE LEGISLATURE.

HARTFORD, CONN.
Press of The Case, Lockwood & Brainard Company
1900.

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State of Connecticut.

REPORT.

"As it is impossible that an enterprise like that of agriculture can be exempt from casualties and accidents, a certain tranquillity of mind must be united with the necessary activity in order to secure a happy life. Whether this be attained by the consolations of philosophy or religion, the agriculturist must learn to support misfortune with resignation; he must forget all the evils which it was impossible to foresee, all those hopes which have ended in disappointment, as soon as he has, by the adoption of prudent regulations, diminished as much as possible their annoying consequences." (Albert D. Thaer, Principles of Agriculture.)

To His Excellency, GEORGE E. LOUNSBURY, *Governor of Connecticut:*

In presenting the annual report for 1899 we feel warranted in the statement that the College has made regular advancement in all its departments. Notwithstanding the requests from some of the instructors for fuller equipment, we desire to express our satisfaction with the conditions we are enabled to offer in every department of the College for instruction in those "branches of learning as are related to agriculture and the mechanic arts." There is only one serious drawback to the full realization of this statement, and that one has been beyond the powers of the Trustees to control.

When Connecticut turned over to the College the funds of the United States Government for "teaching those branches of learning as are related to agriculture and the mechanic arts," the State assumed the responsibility of providing for the College, so that it might fully meet the obligations of the State to the General Government. None of these funds were to be used for buildings or repairs. These must be provided by the

State. The growth of the College has been always in advance of the room in its dormitories and laboratories. The disappointment in not securing from the Legislature of Connecticut, a State so celebrated for its liberality in providing for education, the means required for a library building, drill room, or gymnasium, creamery, and cottages for residence of instructors, suggests to the Trustees that, as uncertain as may be the returns of agriculture to those who depend on it for a living, the case is more than matched by the failure of the General Assembly to provide for these necessities of the College, and we must look to the above quotation from von Thaer for comfort and hope.

The Trustees of the College need this happy frame of mind as well as any farmer does whose crops fail. We trust that the friends of agricultural education will renew their efforts and secure such ample appropriations as are needed.

The teaching force is sufficient to instruct a much larger number of students than we can accommodate in dormitories or classrooms. The Trustees appeal confidently to all intelligent citizens of the State to aid in securing a liberal appropriation from the next General Assembly, that the College be not dwarfed by meager accommodations.

The students come not alone from the farms, but agriculture, the basis of all industries, while it supplies men for other callings, in return is reinforced by those who turn back from the shop and trade to this primal industry of man.

Reference is made to the reports of the different departments of the College, showing the kind of education we offer, adapted to make good citizens, and upon such depends the honor and prosperity of the State.

Very respectfully submitted in behalf of the Trustees,

T. S. GOLD, *Secretary.*

REPORT OF THE PRESIDENT.

To the Trustees of The Connecticut Agricultural College:

GENTLEMEN: — I have the honor to transmit to you my second annual report as President of The Connecticut Agricultural College of the State of Connecticut, for the calendar year ending November 30, 1899.

I therefore respectfully submit the reports of heads of departments, and the annual catalogue for the college year 1899-1900.

The year has passed with no startling events or changes, but with a steady routine of work, which always results in progress; and, when that progress is measured, all conditions must of necessity be taken into the account.

General Remarks. — The foremost colleges, of whatever name, of the present day are those that have the most available means, and the largest and best equipment as a consequence of their means. No one is satisfied with what he has, unless it be the best. And this is right. All progress depends upon a wholesome discontent with the present surroundings, a holy desire for something better, more improved, higher in attainment.

The Congressional act of 1862 was "An Act donating Public Lands to the States to provide Colleges for the benefit of Agriculture and the Mechanic Arts," and this act declared "that their leading object shall be, without excluding other scientific and classical studies, and including military tactics, to teach such branches of learning as are related to Agriculture and the Mechanic Arts, in order to promote the liberal and

practical education of the industrial classes in the several pursuits and professions in life."

This gift of the Federal Government is presented to the several states on condition that the state accepting it provide a college, restrict the funds received from the Federal Government to special uses, and make this college special in its character.

The State of Connecticut, through agents authorized by itself, accepted this gift with the condition: First, to establish an institution of learning, a college in the full acceptation of what the term implies; second, that the State should then become responsible for its college as a part of its public school system.

The United States law, quoted above, specifies the kind of an institution demanded of each State that accepts the aid of the Federal Government, and accedes to the conditions. High grade and wide scope in education is the intent of the law. Such branches of learning as relate to *Agriculture* and the *Mechanic Arts* shall form an important part of the college curriculum, but other scientific and classical studies are demanded with equal emphasis. While a college of this character should abate neither one jot nor one tittle of the law in regard to learning, it is intended to have a wider scope in the training of the hand and eye, as a preparation for the varied industrial pursuits and professions; and no one, in these days of industrial activity, questions the importance of industrial education for those who are soon to fill the ranks of the wage-earners.

The farmer needs, and must have, a working knowledge of the best methods and the best machines, for producing the most potent results in the shortest time with the least labor, or his position will be in the rear of other crafts. But this does not exclude the mechanic from his share of popular education, at the State College, which the times imperatively demand.

Such a scheme for industrial education as has been estab-

lished by the act of 1862, and furthered by the act of 1890, must depend entirely upon State aid for the development of its plant. And our faith is implicit that the next General Assembly will carefully consider the needs of the State College and make ample provision for its necessary expansion.

Name. — Owing to the fact that the name, Storrs Agricultural College, was misleading to the Government officials at Washington, and that the State institution should be designated by such a title as to give it recognition at home and abroad, the last Legislature, 1898-99, changed the name from Storrs to The Connecticut Agricultural College.

The Faculty. — The faculty, with assistants, consists of nineteen persons. At the beginning of the college year there were added Mr. W. A. Stocking, Jr., farm superintendent; Mr. C. E. Myers, instructor in bookkeeping and College accountant; Mr. T. D. Knowles, principal of the preparatory department and instructor in physical culture, and Mr. R. W. Dallas, poultry-keeper and instructor in poultry culture. Mr. L. P. Chamberlain was transferred from the farm to the stewardship of the boarding department, in place of Miss L. E. Saxton, who resigned her position as matron August 1, 1899.

The College Curriculum. — The course of study for the College classes has been improved, and, as instructors testify, with good results.

To the Senior class was given an option on three courses, and these electives have excited much interest. We look forward to the time when the College curriculum may be greatly enriched; when students shall be better equipped at the start, and be able to follow more closely each his bent; and so receive greater advantages than can now be given in a limited course of study.

Student Labor. — The question of compulsory labor by the student body is well worth your consideration, both as to its

financial bearing upon the College, and its physical and intellectual results upon the students themselves.

All student labor at the College should be instructive in the highest sense, and should be reckoned an important part of any course required for a College degree. Give to students, dependent upon themselves from force of circumstances, every opportunity to " work their way " ; but let this be granted to those who are in every way worthy of financial assistance, and not to those who are disorderly or indulge themselves in extravagant or bad habits.

Dwelling-Houses. — There is an ever-increasing demand for suitable cottages for occupancy by the instructors, in which they may find the comforts and conveniences of home life. If members of our faculty are forced to find quarters at inconvenient distances from the College, they labor under disadvantages in many respects, and the College loses much of their influence and society, both of which are very essential to the institution, on account of its location.

Mechanic Arts. — This department of the State College should have better accommodations, and better facilities for instruction and practice in manual training, to say nothing on the question of time devoted to this work.

The following letter to the President, from a member of the Senior class, in regard to " electives," voices the sentiment of many others :

" I came here for the purpose of becoming somewhat proficient in the ' Mechanic Arts,' as well as to learn something about the sciences connected with agriculture, but have been sadly disappointed so far. I believe that this crowding mechanics out of the course as much as possible is proving a great detriment to the College. And I assure you I am not the only one who thinks so. In my opinion, mechanics will be far more useful to me in managing a farm than the instruction in agriculture to be given this winter. . . . By keeping informed on

Experiment Station work one can keep increasing his knowledge of agriculture, but the opportunity for receiving practical instruction in mechanics, to be made useful on the farm, practically ends at close of the College course."

Dairy Course. — The short course in Dairying during the winter term is increasing in popularity, and I would respectfully refer your attention to the suggestions found in the report of that department.

The aim of each, and the combined effort of all, is to develop this plant into a college, with everything which that name implies; that no young man or woman of any wage-earning class may lack the opportunity to improve along the line of his individual talent.

For a clearer and more extensive view of the work of the institution during the past year, permit me to refer you to the reports of the several departments, where the work is set forth in greater detail.

Respectfully submitted,

GEORGE W. FLINT,

President.

REPORT OF THE DEPARTMENT OF AGRICULTURE.

President G. W. Flint:

SIR: — The plan of instruction which was outlined in my report for 1897 has now been followed for two years, and seems to be well suited to the needs of our institution. This plan was formulated originally by a committee of the American Association of Agricultural Colleges and Experiment Stations. The work of instruction at this institution has naturally separated itself into two divisions: (1) Crop Production and Farm Management, (2) Animal Industry and Dairying. The first division has been under my immediate direction, with the assistance of Mr. W. A. Stocking, Jr., who has aided in the work

of instruction with the Sophomore class. The subjects treated have been those which relate to the management of soils, and the production of the leading farm crops, together with the general principles of rural economy and farm management.

Instruction in the division of animal industry and dairying has been chiefly along the line of Dairy Industry. The importance of this branch of agriculture, within our State, emphasizes the necessity of making it one of the leading branches of our instruction. This work has been mainly under the charge of Mr. Beach, and will be found outlined in his report. In addition to the instruction with regular classes, the Short Course in Dairying is proving an important and successful feature. The chief drawback in this division is the lack of a fully equipped dairy building in which to carry on the laboratory and practical work. The present dairy building, which was designed only as an annex or wing to the main structure, is proving entirely inadequate to our needs. We trust that before another special class in dairying shall register the main structure may be completed.

Another important branch of animal industry is that of poultry culture. Since the retirement of Mr. W. L. Chamberlain this branch of work has been placed in charge of Mr. R. W. Dallas. In accordance with the instructions of the Trustees, the work in this division has been made largely instructive. Small flocks of six of the leading breeds of chickens were purchased early enough in the year 1899 to furnish eggs for hatching purposes. This foundation stock has given us flocks of sufficient size to be of great value for purposes of illustration during the present winter (1900). Three Cyphers incubators were also purchased, and have been used in the work of instruction. There is great need of a well equipped brooder-house for the artificial rearing of chicks. The present brooder-house is too low and damp and should be improved by the addition of a vermin-proof foundation, and a cement floor.

The work of the farm has consisted mainly in the production of feeds for the dairy herd, and of such staple farm products as might be needed by the boarding departments. By the action of the Board of Trustees, Mr. L. P. Chamberlain was relieved, on September 1st, from the position of farm superintendent, after fifteen years of faithful service. At the present time the farm is profiting by the important work done under his management, such as the breaking up of new fields, removal of rocks, and the general increase in the productiveness of the farm. The position of farm superintendent has been filled by the election of Mr. W. A. Stocking, Jr., a graduate of this College in the class of 1895, and later of the Agricultural Department of Cornell University.

It will be our aim to make the work of the farm, as far as possible, instructive to the students. This can be done to advantage only by having a full supply of the best modern tools and machinery, and a variety of different kinds and types of farm animals. Much of this kind of equipment is expensive, from the standpoint of financial profit, but it is vastly important from the standpoint of instruction. It is often a valuable means of instruction to have on the College farm such animals and tools, and sometimes to grow such crops, as will not yield a direct profit. While the use of student labor for the sake of getting work done is not advisable, yet as a means of familiarizing the students with the best ways of doing different farm operations, the labor system has a high value. I have indicated in former reports that the two great fields of operation for the farm should be that of instruction and experimentation. For example, such work as the mixing of fertilizers and their application to different crops, the best method of planting, cultivating, and harvesting crops can be more fully impressed when the student engages in the actual operations of the farm than by any amount of theoretical explanation.

One new field was laid out last year for plot experiments,

and a second field will be used the coming season. Field experiments on the effects of fertilizers on the yield and feeding value of farm crops is naturally an important line of investigation in the older states where the virgin fertility of the soil has been largely exhausted. Such experiments, together with the growing and use of forage crops, will constitute two of our leading lines of investigation. The practical experiments with the herd, made by Mr. Beach, on the relative profits of different types of dairy cows, have already attracted much attention. The result of these experiments will be published as a bulletin by the Experiment Station.

Owing to the setting off of quite a large portion of the farm for the use of the Horticultural Department and for general College purposes, such as landscape gardening, building sites, and athletic fields, the general area for farm purposes has been greatly reduced.

If the farm is to supply the dairy and farm products up to the full needs of the boarding departments, and the families on the grounds, it will soon be necessary to increase the cultivated area of the farm. This may be done either by breaking up and bringing under cultivation pasture lands, or by increasing the farm by purchase or lease. As the amount of available pasture lands for the herd is already too small, it would seem to be more advisable to add to the farm by purchase or lease.

Respectfully submitted,

CHARLES S. PHELPS,

Professor of Agriculture.

REPORT OF THE DAIRY DEPARTMENT.

President G. W. Flint:

Sir: — Since making my report a year ago our College herd has been infected by the disease tuberculosis. The orig-

inal source of infection is unknown, but we have reason to believe it was introduced by the purchase of an animal suffering with the disease. The first indication of the malady was in November of last year, when an animal, which up to that time had been smooth, plump, and healthy looking, began to decline, rapidly wasted away, and died inside of a month. The herd was tested with tuberculin, and fourteen animals responded to the test. This matter was reported to the Board of Trustees. Professor Phelps and myself admitted that the slaughter of these animals, followed by thorough disinfecting, would be the surest and quickest way of getting rid of this disease. But for the sake of instruction and illustration, not only to our students, but to the farmers of Connecticut as well, it seemed better in this case that the Bang method and treatment be adopted. This suggestion was finally agreed to, and the herd was divided into a " Healthy " and " Infected " herd, with separate barns, yards, pastures, and watering places. I include in this report the facts as given to the press at that time, not that it is anything new, but that it may here become a matter of record.

Facts Given to the Press. — The College herd has recently been tested with tuberculin and eleven animals out of twenty-five responded to the test. There is a prevailing opinion that the most productive dairy cows, on account of the greater tax upon their systems, are less hardy and more susceptible to tuberculosis than those only moderately productive. This opinion is not substantiated by our experience, as the following observations show.

If these cows are arranged in the order of their butter production, with the one having the highest yield first, then those designated by the following numbers reacted: Numbers 1, 2, 4, 8, 11, 13, 15, 18, 21, 22, and 25. Fifty per cent. fall in the half of the herd having the lowest records. In the same line it is interesting to note that one Jersey out of four, one Guern-

sey out of three, one Ayrshire out of four, and eight grades out of eleven responded to the test. And, according to type, two "Typical Dairy," four "Dairy," three "Lacking Digestive Capacity," and two "Beef Type" responded.

Great care has been taken to avoid the introduction of tuberculosis into the herd. The tuberculin test has been used frequently (once a year). All animals purchased have been tested before, or shortly after, coming into the herd. Up to the fall of 1898 we have had no animals respond, and no known case of tuberculosis. A year ago last November there was purchased an eight-year-old cow (No. 18) of a neighboring farmer. This man raised the cow from a calf, and reports that he never had a case of tuberculosis in his herd, and that he had never used the tuberculin test. Cow No. 18 was tested with tuberculin soon after purchased, and, not responding, and showing no physical signs of disease, was given a permanent place in the herd. A year later she commenced to refuse her feed, ran down rapidly, and died after one month's sickness. An autopsy showed a general and advanced case of tuberculosis. The herd was immediately tested with tuberculin, when eight cows responded, and again, after five months, when three more responded, or a total of eleven out of the twenty-five cows in the herd. The most plausible theory of infection to us is that cow No. 18 was, when purchased and tested with tuberculin, suffering with the disease in an advanced form, and for this reason did not respond to the tuberculin test. It is hardly reasonable to believe that in less than one year she could have contracted the disease, and that it should have developed to the extent that the autopsy showed. Dr. N. S. Mayo, our College veterinarian, reports: "Judging from the extent of the disease, and the number of encysted tubercles, I am of the opinion that the case was one of long standing."

Two courses are open to us in the management of the herd. First, to kill the infected animals; or, second, to isolate those

which respond to the tuberculin test, and keep them under the best sanitary conditions until they show some physical signs of breaking down. In order to form some idea as to the condition of the reacting animals, five of the eleven that responded were killed. The animals selected for slaughter were the ones that showed most markedly physical signs of disease. Four of the five had twice responded to the tuberculin test. The autopsy showed that the disease was, in each case, in the earlier stages of development. The mediastinal gland in each animal was affected, and, in addition, the bronchial gland in one case, and in two cases one lung each, in one animal slightly, and in the other seriously. The animals slaughtered showing so little affection, it was then determined to isolate the remainder of the reacting animals, and keep them under observation.

At present the reacting herd is quarantined in a barn adjacent to the one occupied by the healthy herd. This barn is well ventilated, and admits plenty of sunlight. The infected herd occupy a yard, pasture, and watering place separate from the healthy herd, and at no point do the two herds come in contact. As little communication as possible is permitted between the barns. The attendant who milks, feeds, and cares for these animals waits upon the healthy herd, and later, upon the infected herd, and only in this order. A special oversuit and shoes are provided to be worn by the attendant while at work in the stables occupied by the infected herd.

More stringent rules in regard to communication, even to complete isolation, could be made and enforced, but if this experiment is to be an object lesson of practical value the conditions must be such as could be applied upon any farm. — C. L. Beach.

Commenting on above, Hoard's "Dairyman" remarks: "It is fortunate for us that the Connecticut State College has been forced to take up this question."

In January, before the quarantine was established, the

Cattle Commissioner condemned one animal on a physical examination, and later, in June, five others were condemned, paid for, and slaughtered by the Commissioner. The post mortem showed the condition as detailed above. The rest of these animals are in an apparently healthy condition. The milk from the " infected herd " is pasteurized by heating it to 160° F., and is then used for butter-making. The calves dropped in this herd are fed on pasteurized milk, and five are, up to date, healthy animals.

The healthy herd was retested on December 8, 1899, with tuberculin. One cow responded on this date. It is a question, I think, whether this new case was the result of infection during the summer from the " infected herd," as the result of a too lax quarantine, or whether it might have been an incipient case when the herd was previously tested that has developed since. Should further developments indicate that our quarantine is too lax, other precautions will be adopted. But the writer has urged, if this method of controlling tuberculosis is to be of practical value, that the conditions must be such as could be adopted or applied on any farm.

While the result so far is not all that one could wish for, it will be admitted, I think, that to show whether this disease can or cannot be controlled by a practical quarantine will, in either case, be a successful experiment.

At their July meeting the Board set aside $600 to be used in the purchase of registered stock. It has been thought best not to use this money until we have tuberculosis under complete control in the healthy division of the herd.

Sale of Dairy Products. — Our creamery ledger shows sales of dairy products to the amount of $2,506.56 during the year; about one-third to the families of the faculty, and the rest to the boarding department.

SALES, DECEMBER 1, 1898, TO DECEMBER 1, 1899.

Sold to families of the Faculty, dairy products,	$825.55	
Sold to Boarding Club,	1,266.65	
Sold to Grove Cottage,	201.76	
Sold to Cooking School,	15.87	
Sold to Farm, skim milk,	109.34	
Sold to Allen & Worth,	87.39	
		$2,506.56
Bought of Mansfield Creamery,	$244.91	
Bought of Valentine Estate,	292.65	
Bought of C. H. Savage,	202.28	
Bought of College Herd,	1,766.72	
		$2,506.56

Our records show that the herd contained an average of twenty-two cows for the year and brought in an average income of $80.30 per head.

The products of the herd have more than supplied the wants of the College proper, but purchases have been made to supply the families.

The number of cows will be increased the coming year by six two-year-old heifers of our own raising, but this must be the limit of our production, until more stable-room is available.

Dairy School. — The third session of the Short Course Dairy School opened January 2, 1900.

The first year two students took advantage of the course. Last year six students were in attendance, and this year ten students are taking the course. This course is designed to meet the wants of young men who are unable to take advantage of a longer collegiate course and yet desire a better preparation than can be obtained by practice alone. This course is also planned for young men who intend to engage in dairying upon the farm or in creamery practice. It is the aim to make the instruction as practical as possible, and for this reason, practice with the Babcock test, daily work in the creamery,

and in judging dairy cows is depended upon quite as much as classroom work.

Should the course prosper, it will be only fitting that these young men receive some reward or certificate on completing this work. I am in favor of granting a certificate only after a year or two years of successful work after leaving school. If the student engage upon a dairy farm, let him make monthly reports to this department of the individual production of the dairy herd of which he has charge, the rations fed, etc. If the student engage in creamery work, let him report on blanks furnished the operators of his creamery. Let the instructor visit these students once a year, when they reside within the State, and inspect their work and make suggestions for their good. Then grant certificates only after two years of successful work. This method will have the advantage of making the certificates of some value to the owner, and will also protect the College against those who do not make the most of their opportunities.

The College Herd. — This year, as last, the hay and grain have been weighed separately to each animal in the herd; the milk weighed twice a day, and samples taken and tested by the Babcock test.

This necessitates considerable extra labor and expense which, I believe, is more than offset by the value of the results. The herd becomes of great value as an object lesson in the studying and judging of dairy cows.

No. of Cow.	Cost of Food at Market Prices.	Cost of Food + Cost of Labor (estimated at $24.10).	Value of Products (Butter at 25 cts. per lb and Skim-milk at 20 cts. per cwt.)	Net Profit.	Butter Produced, lbs.	Milk Produced, lbs.
1	$47.97	$73.89	$108.10	$34.21	390	6,361
2	44.28	68.38	101.71	33.33	369	5,681
3	36.46	60.56	92.49	31.93	337	4,946
4	43.56	67.66	90.74	23.08	333	4,496
5	47.20	71.30	93.80	22.50	342	5,982
6	45.01	69.11	91.60	22.49	321	6,852
7	38.70	62.80	83.28	20.48	299	5,120
8	41.13	65.23	79.26	14.03	288	4,356
9	50.39	74.49	88.05	13.54	314	5,733
10	44.56	68.66	81.28	12.62	291	5,151
11	43.81	67.91	80 03	12.12	283	5,570
12	49.67	73.77	82.60	8.83	292	5,767
13	47.56	71.66	80.30	8.64	291	4,529
14	43.33	67.44	75.70	8.26	273	4,470
15	44.11	68.21	76.22	8.01	263	6,281
16	48.38	72.48	78.39	5.91	280	5,035
17	35.74	59.84	61.27	2.43	223	3,312
18	42.15	66.25	62.23	—4.02	214	5,244
19	35.53	59.63	49.54	—10.09	180	2,724
20	33.58	57.68	32.74	—24.94	120	1,644
Av.	$43.24	$67.34	$79.45	$12.11	285	4,912

The above record shows that there are some cows in the herd that are unprofitable, and some even kept at a loss, when labor is taken into consideration. Several of these cows are registered animals, and for purposes of illustration and instruction are as valuable as those that yield larger returns, although they reduce the average production and profit of the herd.

This department has undertaken the study of five or six herds in the immediate vicinity of the College for the next year, offering to furnish blanks for milk records, bottles for milk samples, and also offering to test these samples by the Babcock test, all free of charge. It is hoped this work may bring the College in closer touch with the farmers in this immediate vicinity, and these individual records of seventy-five to

eighty cows will furnish our students greater opportunities for studying and judging dairy cows whose records are known.

In addition to my teaching and regular work of the College I have prepared a bulletin for the Experiment Station, on " A Study of Dairy Cows," also have attended and addressed a number of Farmers' Institutes.

The records and results of the College herd have been prepared for, and have circulated quite extensively in, the agricultural press.

Respectfully submitted,
CHARLES L. BEACH,
Instructor in Dairying.

REPORT OF THE DEPARTMENT OF HORTICULTURE.

President G. W. Flint:

SIR: — The class work in this department has varied but little in amount or character from that of last year. However, the new schedule brings much more of this work into the winter term. It is also intended to increase the amount of class or laboratory work for those members of the Senior class that elect the Horticultural Course. This department is greatly in need of a proper place in which to carry on special work.

The student labor in this department, not needed for care of the grounds and crops, has been used largely in grading new portions of the campus, and in planting trees and shrubs for permanent growth. This work will go on as fast as the campus is ready for final planting.

The special work of the summer term students was underdraining the athletic field. The ditches were dug by outside labor. But all laying out, grading, putting in tile, and filling

was done by the students. Approximately, two hundred rods of tile-draining were completed.

This work, as well as all other done by this department, has been accurately plotted and recorded, so that at any time in the future anyone familiar with the grounds can locate the drains.

During the past year a set of models of types of vegetables, similar to those of fruits obtained two years ago, has been made for the College by the same artist. We are now quite independent of season, with specimens mounted for class work or study.

Just before the close of the year this department was authorized by the Board of Trustees to select a proper site for a commercial apple orchard. This will be needed in the near future to supply fruit for the College, as the fruit trees now on the campus will sooner or later be removed.

After much deliberation a tract of land was selected at the west end of the "Crane Farm." It contains about ten acres nearly square in form, well elevated and protected, and in fair condition. This was all plowed, and some of the surface stone removed before winter set in. It is intended to plant the trees early in the spring. The trees to be set will all come from the College nursery.

Several of the methods used by orchardists will be employed in the growth of this orchard. But to make it a paying investment will be the end to be strictly kept in view.

Much of the detail work of this department has been looked after by my assistant, Mr. Walter A. Warren. It being his second year in this position, his familiarity with its duties makes his labor very satisfactory. The choice of Mr. Fred J. Baldwin, a Junior, to assist in the greenhouse and on the lawns, was a very fortunate selection.

Respectfully submitted,

ALFRED G. GULLEY,

Professor of Horticulture.

REPORT OF THE DEPARTMENT OF RHETORIC, ENGLISH LITERATURE, ELOCUTION, AND ETHICS.

President G. W. Flint:

Sir: — This is my third annual report. English is the only language taught here; and it is designed that, as soon as possible, the inducements and facilities for its study shall be made second to none offered elsewhere. Improvement in the English part of our library is immediately reflected in the results achieved by the classes in English. It therefore is a cause for the greatest gratification that, from time to time during the past year, but particularly recently, there have been added to our library a considerable number of books for the especial benefit of readers and students of English. Other books have been recommended, and are being secured as fast as the resources of our library permit.

Along with the promotion of good reading among the students, and of their power to express their thoughts in good English, the greatest effort has been made to develop forcible and pleasing speakers. To this end the students in the two lower College classes, and those in the preparatory department, have been required to speak at public exhibitions three times during the year. This new rule will be followed in the future, and the improvement in the speaking ability of the students thus secured will make possible more advanced training during the last two years of the College course.

Much importance, from the first, has been attached to the addresses delivered at our chapel services by the members of each Senior class. The greatest interest has been shown, and the preparation has been most painstaking. It is not uncommon for an address to be reconsidered and rewritten three times; a large number have been so treated five times; and three, seven times. But the delivery of these addresses has been from memory.

To supplement this training of the Seniors, extemporaneous speaking has been introduced during the past year. No one was asked to speak extemporaneously until the beginning of the winter term. At that time each Senior had prepared and delivered an address at one of the chapel services, and therefore had arrived at some definite conception of the elements which go to constitute successful public speaking. And each had been given experience in extemporaneous speech at one or more of our class exercises before being called upon to speak at the evening chapel service.

The chapel services began at a quarter before six o'clock. In the morning I notified the students who were going to speak to come to me at five o'clock for the assignment of their subjects. Time enough was thus given for each speaker to collect and organize his thoughts, but not enough for writing and memorizing. Subjects of great variety were assigned, but only such subjects as could be treated profitably and interestingly in the three to five minutes allowed. To each student was given the subject upon which he seemed at the moment best fitted to speak.

Some of the extemporaneous speeches thus given were excellent. And experience in this form of address is to be made a permanent feature of the future training of our Seniors.

Because of their promise, therefore, these three things — the improvement in our library for English study, the attention now paid to speaking in the preparatory department and in the first two years of the College course, and the introduction of public extemporaneous address in the Senior year — may be found worthy of your notice.

My instruction the past year has been confined, as before, to the Junior and Senior classes, and has had to do with my original subjects. And since the following announcement of the different courses given by me may, perhaps, sufficiently indicate the more prominent features of my instruction, it is placed here before you.

JUNIOR CLASS. SUBJECTS: RHETORIC AND ELOCUTION.

Rhetoric. — Three terms, three hours a week. Three essays.

Two text-books are used in this course, Waddy's "Elements of Composition and Rhetoric," followed by Hill's "Foundations of Rhetoric." The students write constantly, and their writing tests their mastery of the text-books.

Outside reading is assigned from week to week, and each term every student chooses a good book which he, in writing, critically reviews.

There are lectures. The instructor reads and discusses masterpieces of English. And critical help is given each student.

In this course English is studied about equally for the joy and utility of its mastery, and for the awakening or the quickening of the love of good reading.

Elocution. — Three terms, one hour a week, and private appointments with each student. For the technique of delivery, no text-book is used. ("Practical Elocution," by Fulton and Trueblood, is referred to for special points, but is not bought by the students.) But for the basal philosophy of delivery, and for practice in reading aloud, the students study Curry's "Lessons in Vocal Expression."

The course begins with the rudiments of pantomimic training — education in the language addressed to the eye in public speech. It then takes up vocal training — education in the language addressed to the ear. And its ultimate effort is to co-ordinate these two great elements of delivery.

Public "rhetoricals," in which every member of the class takes part, are given each term.

The aim of this course is practical, to promote good address.

SENIOR CLASS. SUBJECTS: ENGLISH LITERATURE, ELOCUTION, AND ETHICS.

English Literature. — Fall and winter terms, three hours a week. A comprehensive essay.

Three text-books are used in this course: "English Literature," by Stopford A. Brooke, with which is bound Harriet L. Mason's "Student's Readings and Questions in English Literature"; "An Introduction to the Study of American Literature," by Brander Matthews, and "From Chaucer to Arnold, Types of Literary Art in Prose and Verse," by Andrew J. George.

The students fix the different periods by identifying their leading writers, and by reading examples of what these writers have written. And this takes them beyond these text-books.

Notes are made. There are frequent twenty-minute, half-hour, and hour reports. And these reports of the reading done are written in class, and from memory alone. Each student also chooses one modern writer, studies his life and works, and, on or before March 1st, presents his results in a comprehensive essay. And with this essay is submitted a careful bibliography of the reading done in its preparation.

During January sections from the preliminary notes of these comprehensive essays are reported to the class. And careful notes on these reports are made by the students, in order that all may benefit by what each does. The text-books contain excellent bibliographical material. And the text-books and notes together are intended to furnish intelligent guidance in fuller reading after graduation.

The writing of each student receives careful criticism. But, apart from criticism, the chief office of the instructor is guidance and suggestion. This includes introductory lectures on books and reading, and the continuance of the reading and discussion of English masterpieces begun in the Junior year.

In this course, English is studied about equally to give increased command of English speech, to give good training in research, and to enrich those resources in the students which, in after years, shall help them to keep the company of the noblest minds.

Elocution. — Fall term, one hour a week.

This course advances from the rudiments of pantomimic training into the more elaborate parts of the language to the eye. In vocal training, also, it continues the cultivation of the language to the ear. And it undertakes, in the case of each student, to carry the co-ordination of these two great elements of delivery up as far as possible from the lower into the higher forms of address.

Senior Addresses. — Three terms. Three addresses. Private appointments with each student. Each member of the class prepares one address each term, and delivers it in public without notes.

Subjects are chosen which are of peculiar interest to the students themselves, and about which they have acquired some previous knowledge through reading, travel, or study. They are chosen, so far as possible, for their timeliness, and they are treated with especial reference to the audience expected.

The greatest care is used in preparation. The subjects are chosen six weeks before the date of delivery, and both writing and delivery receive the constant criticism and suggestion of the instructor.

The Senior addresses are of the utmost value, both as a means of discipline in themselves, and as giving practical point to the instruction in English and elocution.

Extemporaneous Speaking. — Winter and spring terms. Members of the class, at the discretion of the instructor, are asked to speak extemporaneously in public. The shortest reasonable notice is given; the object being to keep the preparation entirely free from writing and memorizing.

The subjects assigned each are those upon which the students are naturally prepared by experience, or by recent reading and study, to speak.

This exercise is intended to turn to ready account the training afforded by the Senior addresses, and to develop the ability of each member of the class to think and to express thought, pointedly and progressively, under circumstances quite as trying as those likely to be found at the grange assembly, at the political caucus, or at the town meeting.

Ethics. — Spring term, two hours a week. A thesis. Here the text-book is Janét's "Elements of Morals." Muirhead also is read, and other reading is provided and encouraged.

Reports and digests of this reading are written from memory in class. Besides, each student chooses a special topic in ethical fact, or theory, does a careful piece of research, and, as early as two weeks before Commencement, presents his results in a thesis.

Also there are lectures, as the exigencies of the course either permit or demand.

In this course, ethics is studied as the science of conduct.

If, in addition to the above announcement and the preceding remarks, you should be interested to review the pedagogic aims and principles involved in my instruction, I would refer you to a rather full discussion of them in my first report, to be found in the Annual Report for 1897, pages 27 to 39. Or, if you should prefer it, a short summary of the variety and character of the training afforded by my courses may be found in the Annual Report for 1898, pages 18 to 19.

Respectfully submitted,

RUFUS WHITTAKER STIMSON,

Professor of Rhetoric, English Literature, and Ethics.

REPORT OF THE DEPARTMENT OF CHEMISTRY AND PHYSICS.

President G. W. Flint:

Sir: — The work of the department over which it is my privilege to preside has, in general, continued along the lines marked out in past years. The introduction of electives for members of the Senior class has made it possible to provide more extended courses for those who wish further work in chemistry and physics.

The schedule, as arranged at present, provides for one term of five exercises per week for chemistry in the second term of the Freshman year. This work consists of text-book and lecture demonstrations. An occasional period is given to laboratory manipulations, so that the student carries on experimental knowledge in subjects introduced by the text-book. This is followed in the spring term by a course in qualitative analysis in the laboratory.

By this arrangement, students who enter College at the opening of their Sophomore year miss these two terms of work, which are fundamental to all their future work in chemistry during the course. To provide for such students a special class was formed during the fall term, and the text-book was gone over as rapidly as possible, and one afternoon a week given to laboratory work. While this is not altogether satisfactory, it seems the best arrangement possible at present. While one division was taking this work the other division that had finished the work took up a short course in physical geography at the same hour.

The subject of physics was studied by the Sophomore class during the fall term, for a period of one hour and a half per week for laboratory manipulations. This work I regard as of great utility, and prepares the student for the work of the term following, in the text-book, which is pursued for two hours per

week during the winter term. This is continued in the fall term of the Junior year, when the subject is completed, except the chapters on electricity, which it is proposed to extend considerably, and to offer as an elective during the Senior year. In order to provide for this special elective course in electricity it will be very desirable to have a considerable addition to the present equipment in that line of work. With this prospect before us, the work in the subject of physics will receive a much more adequate treatment than has been possible in past years.

In the department of chemistry, to the Sophomore class is given a course in volumetric analysis for a laboratory period of two hours per week during the winter term. The training that this course provides in the way of careful, exact manipulations, and the training it provides in mathematical work and in logical processes makes it of special value from a pedagogical point of view, as well as of value as a training in the science of chemistry.

During the spring term of the Junior year a course in agricultural chemistry is provided, which, for want of a suitable text-book, is given in the form of lectures. This course is appropriately followed by an elective course, during the Senior year, of quantitative analysis. This work comprehends a thorough drill in the analysis of fertilizers, of soils, of feeding products, and other matters closely connected with practical farming.

An elective course is offered during this year, also, for the young women of the Senior class, in the quantitative examination of foods, determination of adulteration of food products, and general consideration of chemistry as related to domestic science.

During the past year, a term of work in mathematical problems related to the science of physics was provided for the Senior class. This is a practical study of great value, and was pursued with excellent results by the class of 1900. It is a

pleasure to commend the special excellence of the final paper submitted by one of the class, Miss Edna M. Nason, which was a solution of twenty-five problems selected from various sources.

Provision is made for a course in Meteorology for the Senior class, which will be in extent and thoroughness much more satisfactory than the brief time allowed for this subject in past years.

This brief sketch of the various lines of study and research, carried on in the laboratory of the chemical department, is but a suggestion of the variety of interests that gather about this department.

Owing to the lack of suitable recitation rooms in other buildings, this building has accommodated classes for Mr. Beach in dairy work; also lectures are given by Dr. Mayo, and laboratory work, in bacteriology; and it provides an office and storeroom for the veterinary department. In order to accommodate these various demands upon the chemical laboratory it is very desirable to have the heating facilities adequate to the demands. The present heating outfit was not intended to provide for more than one story of this building, and at present we need to have the use of the upper story the entire year, and the present heating facilities are not sufficient for this. There should be an enlargement of the heating plant as soon as possible.

In addition to the foregoing work with the regular classes of the College, this department has undertaken to provide a course in physical and commercial geography for the students of the preparatory department. This is given in a series of text-books with two periods a week during the College year.

Respectfully submitted,

ARTHUR B. PEEBLES,

Professor of Chemistry and Physics.

REPORT OF THE DEPARTMENT OF NATURAL SCIENCE, POLITICAL ECONOMY, AND CIVICS.

President G. W. Flint:

SIR: — I am again reminded that another year's work has been completed, and that it becomes my duty to give account of my stewardship in the year just closed.

My work is entirely with the two upper classes, and during the past year has been in the same lines as in preceding years, and includes Geology, Mineralogy, Zoölogy, Ornithology, Political Economy, Economic Entomology, and Civil Government; and in a general way my report of a year ago could be made to cover the work of the year just closed. Yet we trust that there has been marked improvement, for in these days of progress it is a very poor workman that does not do his work much better each succeeding year.

The course is so crowded, and so many important subjects are clamoring for place in the list of studies, that I find myself much hampered by the lack of time for the satisfactory development of any one of the above branches.

Perhaps in my teaching no other subject has brought so much of satisfaction as Economic Entomology, which was pursued during the entire eight weeks of the midsummer term; as this was an ideal period for that work, and indeed the only time of the year when this subject can be studied to the very best advantage; for then we live in the midst of a wealth of insect life, and the conditions for study could not be more favorable, so far as our surroundings are concerned, than those under which we work here, for the orchards, gardens, fields, meadows, and forests are convenient of access, and always abound with insect life, thrusting itself upon the attention of the honest student.

The aim has been to gain a general knowledge of the insect world, and more particularly of the destructive pests; and

to this end the students give special attention to making collections of the principal forms that are available during the summer term, and to familiarizing themselves with the life, history, and more destructive habits of the most important pests, and the most recent information as to how their ravages may best be checked.

The class made individual collections as part of the required work of the term. These they are required to mount properly and name, and at the close of the summer term their collections are submitted to a committee, and the three best collections are labeled and placed in the College Museum for the coming year.

Mr. A. V. Osmun of Danbury won first place in this contest; Miss Edna M. Nason of Gurleyville, second, and F. J. Baldwin of Watertown, third.

In addition to the work in Entomology, one day each week during the summer term was given to Economic Ornithology. In this work two phases of the subject were kept constantly in view; to become familiar with the common birds about us, and their economic relations to man. During the brief time allowed to this very important subject the live birds were studied in their native haunts, as well as the mounted specimens of the museum. Some attention was given to the anatomy and physiology of birds, their classification and distribution, but our time was chiefly occupied with the subject of what birds eat, and hence their economic relations to man.

The Biological Survey of the Department of Agriculture, Washington, D. C., has made very extensive investigations of the food habits of a large portion of our birds, examining the contents of their stomachs at all seasons of the year, in all quarters of the United States, and thus has gathered very reliable information as to what the birds eat, what ones are man's enemies, and what are his friends, what are destroyers of noxious animals or insects, and what birds prey upon the products of the farm, orchard, or garden.

Large use was made of this exceedingly valuable fund of information in our study of bird life, and in its bearing upon economic questions.

A large number of our native birds are already mounted and on exhibition in the museum, and we hope ere long to have specimens of all of our Connecticut birds in the collection. We have them mounted in pairs, so as to show the differences in the sexes, which is often very great, so great that the male and female are often entirely unlike in color, size, or markings.

The rest of the animal kingdom, corals, starfish, worms, fish, reptiles, and animals, has received its due share of time.

The course in Geology and Mineralogy was much the same as during the previous year, except that more excursions were made into the fields and hills, among the rocks and ledges, for special study of rocks and minerals and geological phenomena. The study has been changed to the fall term, and since Geology is preëminently an outdoor study, the pleasant days of that season of the year and the condition of the ground suitable for walking are much more favorable to the study than either winter or spring.

Large use was made of the lanterns and slides to illustrate geological phenomena which are not found in this vicinity. Here, as elsewhere, we hope to improve the course of instruction by more equipment, and more time for the subject.

In Civil Government and Political Economy each study is carried through one term, with as many lessons per week as time will allow, and the fundamental principles of each subject are considered, and a substantial beginning made, in the understanding of the facts which underlie our citizenship, the constitution and laws of the State, and of the United States, and the economic questions which surround the progress and the complex conditions under which we live.

These subjects open up a new phase of life to the student and widen his horizon in his personal relations as a citizen of

State and nation, and we trust that these very important studies will bear their due share in the making of the men and women of the future.

No small item of my work during the year, aside from my teaching, collecting new specimens, and re-arranging and re-labeling the natural history collections in the museum, has been a large correspondence in answering inquiries concerning insect life. Many specimens have been received, and inquiries made, and information asked concerning all sorts of insects and other animals, both noxious and beneficial.

Respectfully submitted,

BENJAMIN F. KOONS,

Professor of Natural Science, Political Economy, and Civics.

REPORT OF THE DEPARTMENT OF MATHEMATICS, HISTORY, AND FREE-HAND DRAWING.

President G. W. Flint:

Sir: — The subjects in which I give instruction are Mathematics, European History, and Free-hand Drawing. In most of these the courses are the same as last year. In the Senior Mathematics the work is almost entirely new. The Junior, Sophomore, and Freshman classes are pursuing their studies under me in the order outlined in my last annual report. Arithmetic is confined to the preparatory class, and the transition to the new schedule is now completed.

The subjects, classes, and hours appear below:

Algebra. — Freshman class, four hours a week, three terms. This class studies, in addition to the fundamental processes of Algebra, the various forms of equations, roots, powers, proportion, progressions, the binomial theorem, logarithms, permutations, and combinations. The theory of geometric progression is developed and applied extensively to the solution

of problems in annuities, accumulative investments, endowments, and bonds. Especial attention is given to the equations, because of their frequent occurrence in more advanced subjects.

Plane Geometry. — Sophomore class, four hours a week, three terms. In this all the theorems are demonstrated, and considerable practice is given in plotting and working examples. A portion of the time of the spring term will be employed in " pacing-survey " and in " hand-leveling."

Solid Geometry. — Junior class, three hours, fall term. Theorems of lines, planes, and solids are studied, and examples are given in finding areas and volumes of solids. Facilities for teaching this subject have been increased by the addition of new models. A part of this course has been surveying, *i. e.*, the class learned to calculate areas by latitude and departure, and in parties of two surveyed two fields each.

Trigonometry. — Junior class, three hours a week, winter term. All of plane trigonometry is covered, and so much of the spherical as time will allow.

Senior Mathematics. — Five hours a week, two terms. This course will be theoretical during the winter term, and practical during the spring term. The theory will include instruments and their uses, kinds of surveying and problems, as given in Raymond's Plane Surveying; railroad curves and railroad surveying, as set forth in Searles' Field Engineering, and theory and practice in computing earthwork excavations. The spring term will be employed in field work, and in reducing the observations. It is expected that each student will become proficient in the various positions in a surveying party. The young men of the Senior class, with one exception, have elected this subject, and for them the course should be educational in the way in which all mathematical studies are — training the mind to difficult and precise reasoning. And, furthermore, it is expected that the field work will afford a kind of executive

training, which will be of value in any occupation, and that it will be necessary for each student to systematize his work in order to deal with a multitude of details. It is this training, as well as the subjects studied, which has made engineers managers.

The quantity and the quality of the work in Algebra, Geometry, and Surveying shows a great improvement upon my course of two years ago. The time given to each study is now ample for the field to be covered.

European History. — The Sophomore and Freshman classes united twice a week during the fall term to form this history class. Professor Adams' new European History was used as a text-book. The class hour was utilized, for the most part, in discussing the subjects assigned for study. Each member of the class was required to write on special cards provided for the purpose, ten questions covering what in his opinion were the chief points. This was done partly for the practice of selecting the essential points of the lesson, and partly in lieu of daily recitations, which in so large a class were not feasible. In so brief a study of so long a period, beginning with prehistoric man, and tracing roughly his development through the early nations of Western Asia, and through Egypt, Greece, and Rome, and well on into the Middle Ages, a full statement of facts has not been possible, but it has been within our reach, and it has been my constant endeavor to furnish such an outline of history, and to arouse such interest as may lead a student to understand, more or less adequately, a reference to historical matter, and as may lead him in future time to read history for his cultivation and pleasure. In addition, each member of the class has prepared a paper upon some topic connected with our study. Here the work was individualized by assigning a separate subject to each student, and by inducing him to use all the means at our disposal to inform himself upon his topic. (Histories, biographies, encyclopaedias, historical novels, and

the magazines, in recent years so rich in historical articles, are the chief means at our disposal.) After making a preliminary report upon his topic he made his composition from his notes, and in some cases with such full treatment as to double or triple the minimum requirement.

About thirty members of the class went with me to the Slater Memorial building, Norwich, for a day's visit, and by the courtesy of the officers of that institution were cordially welcomed and instructed in regard to the collections. The city itself furnished ample illustrations of styles of architecture.

Free-hand Drawing. — Freshman class, two hours a week, fall term. This is one of the few subjects in which it is possible to see from week to week whether there is any improvement in the student's work. Instruction is entirely individual, likewise any success. The interest shown by most of the members of the class and the excellent results obtained, considering the brevity of the course, are gratifying to their instructor.

The introduction of a preparatory class into our course has made possible a better classification of candidates for admission and has tended to improve classwork by virtue of less disparity of ability, and, by raising the standard of the Freshman class, has expanded the course of all classes.

Respectfully submitted,

CHARLES AUGUSTUS WHEELER,

Instructor in Mathematics, History, and Free-hand Drawing.

REPORT OF THE DEPARTMENT OF SOPHOMORE AND FRESHMAN ENGLISH.

President G. W. Flint:

SIR: — My report will not be materially different from that of last year. The plan of work then in progress was continued throughout the year. I mentioned in my last report the di-

vision of the Freshman class into two sections, one of which formed a preparatory department. The members of this department, as well as those of the Freshman class, studied United States History last year, and thus were able in this, their Freshman year, to study General History with the Sophomore class.

My instruction, consequently, is now confined to Elocution and English in the Freshman and Sophomore classes. Both classes, though one class is in advance of the other, use the same text-books. They have the same number of recitations and follow the same method of study. I shall make, therefore, but one report for the two classes.

Elocution. — One hour a week, and private appointments with each student. Two text-books are used in this course, "The Children's Hour, Paul Revere's Ride, and Other Poems," by Longfellow, and "Classics," by Dr. Curry.

My aim in teaching elocution is to stimulate clear, definite thinking in the interpretation of literature, appreciation of the author's sentiment, and perfect expression of both thought and feeling, and to promote good address at all times. The body and voice are often unresponsive to the action of the mind; and, because of this fact, it becomes necessary, if good expression is to be secured, to train separately the mind, the body, and the voice. In harmonic training of the body no text-book is used. I follow the method pursued at Dr. Curry's School of Expression. I have tried to secure, not great muscular strength, but perfect poise of body, stability at the center with perfect freedom of all the parts. When poise is established, and the body has become flexible, practical exercises in pantomime are given.

Good quality of voice is dependent upon several things, of which the most important is correct breathing. It is not the amount of breath emitted, but the amount held in reserve, which gives power to the speaker. I have endeavored to se-

cure proper control of the breath; to co-ordinate the relaxation of the throat, and also to obtain pure tone and distinct articulation.

Although mechanical training is useful and often necessary in the development of pantomime and voice, it can accomplish nothing unless it is dominated by thought and feeling. The study of elocution, therefore, must begin with the training of the mind, and this must be continued through the entire course. The training is carried on in three ways: by reading, by recitation, and by extemporaneous speaking. Each student reads in class a selection from some author. Public "rhetoricals" are given once each term. Up to the present time the selections for these rhetoricals have been chosen from miscellaneous authors, but this year a slight change will be made in that respect. Two Longfellow recitals will be given, one in the winter term by the Sophomore class, and the other in the spring by the Freshman class. In preparation for the recitals the students are reading Longfellow's poems, both long and short, his prose works, and his biography written by Samuel Longfellow.

The study of Longfellow and his works furnishes good material for extemporaneous speaking, but it is not the only material which is used. The personal experiences of the students, the places they have visited, and the entertainments they have attended, give information which adds to the variety and interest of the exercise.

By education of thought and feeling, and by responsiveness in body and voice, it is hoped that good expression will result. Thus far the results are promising.

English. — Four hours a week. The text-book used is Sheldon's "Advanced Language Lessons." This is supplemented by Maxwell's "Advanced Lessons in English Grammar," and Buehler's "Practical Exercises in English." My

aim is to help the students in acquiring the power to use, with accuracy and ease, good English.

The work consists of technical Grammar and Composition. The principles of the former are applied to the latter. Careful attention is given to neatness, spelling, and punctuation in all forms of composition. These forms consist of dictation, reproduction, business and social forms, observation stories, invention, paraphrase, abstract and original composition.

Much of the material used for composition is that mentioned under extemporaneous speaking. The life and works of Longfellow are of especial value. Thus the study of Elocution and English together is helpful in this, each strengthens the other.

Respectfully submitted,
LUCRETIA J. BARBER,
Instructor in English.

REPORT OF THE DEPARTMENT OF BOTANY AND MILITARY SCIENCE.

President G. W. Flint:

SIR: — In the department of Botany the course of study is much the same as outlined in my report of last year. The Freshman class received five hours per week in the spring and fall terms, and four hours each week in the winter term. The Senior class had four hours a week in the winter. This year the Freshman class will have five hours each week of the year, taking, as before, the elements of structural, systematic, and physiological botany.

Each student collects and arranges in the spring term a herbarium of fifty native wild plants. Kellerman's Elementary Botany, Practical Studies in Botany, and Gray's Manual of Botany are the text-books used.

This year the introduction of elective courses in the Senior class makes it possible to offer to this class more complete

courses in the lines of study offered for election. As a result the botany for the Seniors, instead of being confined to one term four hours per week, will this year comprise two terms of six hours per week. This will be laboratory work, supplemented by lectures, and will cover as fully as possible in that time systematic botany, fungous diseases of plants, and physiology of plants.

Campbell's Structural and Systematic Botany will be used as a text-book, and frequent reference will be made to the more comprehensive works with which our library is well equipped.

Military Science. — The work of the military department has been as outlined in the report of last year. Drill has been held three times weekly, and a record kept of the attendance. Military inspection of dormitories has occurred regularly each week, and quarters have been frequently visited during the week.

In the spring term the Junior class (now Senior) received instructions in the Drill Regulations, recitations occurring at one of the drill hours prescribed each week. The drill of the other classes at these times was in charge of the cadet officers. It is expected that three of the classes will receive instruction in the same way during the winter term.

Respectfully submitted,

HENRY A. BALLOU,

Instructor in Botany and Military Science.

REPORT OF THE DEPARTMENT OF DOMESTIC SCIENCE.

President G. W. Flint:

Sir: — As I look back over the three years during which this department has been under my charge I believe that the amount and the quality of the work has fulfilled much of what it promised at the beginning.

The members of the present Senior class began the prescribed course in this work in their Sophomore year, and during these three years have completed the full course as originally laid out.

I believe the good results accomplished by this class to be a safe criterion of what may be done by every class of young women that completes this course. The training here received fits young women not only to be intelligent and skillful housewives in their own homes, but also does much to prepare them for professional life along whatever line of this work they may select.

Several of the pupils have become so much interested in this work, and so thoroughly convinced of its need in the world, that they intend to continue their study in a normal college, and thus prepare themselves to teach any or all of the branches of domestic economy.

Several of the Senior girls have selected for their chapel addresses subjects relating to domestic science. This is an advantage to themselves in that they gain further information on these subjects, and is also an excellent method of bringing these subjects to the attention of the members of the faculty and the body of the students.

The practical work in Domestic Economy has familiarized the students with the various methods of housework in all its branches and has convinced them that the proper organization and maintenance of an ideal home depends upon the education and training of the home-maker-in-chief for the profession of home-making.

The young women of The Connecticut Agricultural College are being educated away from that hitherto popular fallacy that " every woman, merely by virtue of being a woman, should be a good housewife, and, if she is not, it is due to some fault of her own."

Our original course in Domestic Science, both in theory

and practice, has been quite closely adhered to throughout the last year. During the fall and winter terms the Sophomores have devoted two hours each week to practical lessons on cookery; these lessons are supplemented by talks on the selection, cost, and nutritive value of foods, and also upon "waiting" and "serving." We begin with simple cookery and gradually take up more complicated work, until, toward the close of the winter term in the Junior year, every student is able to prepare properly, skillfully, and easily any dish found in the cook-book.

These lessons include methods of cooking applied to meats, vegetables, soups, breads, cake, pastry, and made-over dishes of all sorts. In the spring term every member of the Junior class prepared and served, without any assistance, a supper of three courses for six persons. The guests in each instance were chosen from among the faculty and students, by the cook and hostess. These suppers were of great value to the students who gave them, and proved very pleasurable to the guests.

With the work in cookery already mentioned, much has been done along the line of canning, preserving, and pickling of fruits, the making of jellies and jams, and canning vegetables.

The Senior class have also spent some time in making menus for a family of six, and in estimating the cost of the same, keeping if possible within a certain limit per head per week. In addition to this, students have scheduled the work to be done every week in an ordinary home, and have estimated the amount of time required to do the same.

In theory, weekly lectures have been given in subjects relating to Domestic Economy. These have included the subjects of hygiene, emergencies, home-nursing, prevention and care of contagious diseases, diet in disease, science of nutrition, chemistry of foods, dietaries applicable to age, and hygienic and economic value of common foodstuffs.

This year we hope to have time for advanced work in home economics as distinct from the subjects above mentioned.

The work in sewing has required much time, but much has been accomplished. This of course is pursued throughout the three years of the College course, and includes every sort of plain hand-sewing, such as running, hemming, stitching, gathering, darning, mending, patching, etc.

After each piece of work is finished, it is sewed into a book and explanatory notes are written on the opposite page. After the book of samples is complete, the Sophomores cut and make a number of small sample garments, upon which they learn to use the machines and their attachments. This work prepares them for cutting and making larger garments for themselves. This work is usually done in the Junior year.

The Senior work in sewing requires six hours every week during the year. All the time is devoted to dressmaking. Each pupil measures a classmate, drafts a paper pattern from these measurements, then cuts and fits a waist lining. The dressmaking includes the making of cotton shirtwaists, both with and without linings, entire cotton gowns, a silk waist, and a wool dress. Several of the students do considerable dressmaking, besides the required work. Last June two of the Senior girls made their graduating gowns. This year we hope every one of the class will do so.

The laundry course has included the washing and ironing of all simple wearing apparel, white and colored; also the laundering of fine fabrics, linens, laces, embroideries, woolens, and colored silks. Instruction was given in the proper use of washing powders, starch, bluings, with the chemistry of soap-making. Students were also taught how to remove spots and stains of every sort.

Boarding Department. — The family at Grove Cottage this fall is larger than at any time previous. In fact, we have had at times more guests than we could comfortably accommodate.

We shall need a larger equipment in the dining-room in the near future.

With the efficient assistance of Miss Edwards, the members of the household are provided with good wholesome food, with as much variety as possible, at a minimum cost. There have been no cases of serious illness, and very little even slight sickness.

I believe a change in the present system of housekeeping at the cottage would be an improvement. As it is now, all the work of the house except the cooking is done by the young women students, but on account of the crowded curriculum the girls do not have sufficient time to do the work as thoroughly as it should be done, consequently it is hardly possible to keep the cottage as clean and in as good order as it should be kept in an institution of this kind. I believe this might be remedied by hiring a janitor to do all the heavier and harder part of the work. It is, without doubt, excellent practice for the girls to do this sort of work, but time for it should be allowed on the regular schedule, as is done for the boys.

Respectfully submitted,

MRS. MAUD K. WHEELER,

Instructor in Domestic Science.

REPORT OF THE DEPARTMENT OF MECHANICS.

President G. W. Flint:

Sir: — In presenting this my fifth annual report of the mechanical department of The Connecticut Agricultural College I wish to express some feeling of satisfaction in the fact that each year marks an era of substantial progress.

If this progress is not as rapid as we might wish it is still an evidence that the great industrial class, employed in the mechanic trades and arts, may yet find in this institution the

facilities for obtaining a technical education that will fit them to hold the place they occupy in the front rank of the great manufacturing states of America.

Iron Shop. — We now have a well-equipped iron shop, with ten modern forges, each of which is supplied with steel anvil, four pairs of tongs, hammer, and other tools. The shop is also furnished with a patent drill-machine, bolt trimmer, sledges, vices, files, bolt cutter, and plumber's pipe-fitting tools.

We also carry a stock of coal, steel, and iron, for use in the practical work that is done each winter and part of the spring term by the Senior class. At present the time allowed for iron work has been increased to six hours per week, and instruction is given in properly heating and forging iron and steel, welding, filing, bending, and tempering.

Although the time for practice is not sufficient to obtain great proficiency, yet the knowledge and skill acquired will be of great service on the farm in repairing the various implements and machines there used.

Wood Shop. — The wood shop is furnished with ten benches, each of which is supplied with a full set of bits with patent brace, a set of firmer chisels with mallet, patent jointer and block planes, draw shave, compasses, try square, level, mortise gauge, saws, nail hammer, screw-driver, and various other small tools. Each bench has a strong wood vice with iron screws, and is fitted with drawers in which tools are kept. The shop is supplied with a limited number of wood clamps, steel squares, and various tools and appliances.

New Machines. — A marked improvement has been made the past year by the introduction of three new machines and two patent miter boxes. The most useful of these machines is a " combination machine," operated by foot or hand power, with rip, cut-off, and scroll saws, and boring, plowing, dadoing, and rebating attachments.

The next is a lathe operated by foot power, and the last a foot-power mortising machine. All of these machines are valuable in the absence of other power.

Instruction is given in the care and use of all these tools and machines, and the work done is always an attraction to those interested in mechanics. Instruction is also given in the use of the steel square as applied in laying out the various parts of a frame building, thus imparting the most important rules of carpentry.

At present the Junior and Sophomore classes receive instruction and practical work in this shop.

Mechanical Drawing. — This is also an important branch of instruction in mechanics. At present all except the preparatory class receive instruction in this branch, and, as a rule, apply themselves with assiduity and profit.

The first work undertaken by any class is drawing the various problems in Plane Geometry, interspersed with intricate designs for pen and compass practice, nearly all the designs being such as shall impress upon the mind not only those scientific principles that govern geometry, but also those practical rules that enable the mechanic to properly design and lay out his work.

Later, Solid Geometry is taken up, its principal value being the practice of drawing in perspective.

The Senior class take up architectural drawing, and each year are able to exhibit work that is a credit to them, and shows good results for the time allowed this branch.

In order to interest the classes in the work of this department, the one in charge often gives short lectures on the subject, which are intended to add enthusiasm as well as instruction. It is also intended that at least two illustrated lectures will be given in the College chapel during the winter term.

The erection of new buildings and the repairing of those already erected has now officially been placed in charge of the

head of this department. Although a lack of funds has prevented the erection of new buildings, which are greatly needed, there has been the usual amount of minor repairs, and it is earnestly hoped that the near future will see the erection of some greatly-desired and much-needed buildings.

Respectfully submitted,

HENRY S. PATTERSON,

Instructor in Woodwork, Ironwork, and Mechanical Drawing.

REPORT OF GROVE COTTAGE AND THE DEPARTMENT OF MUSIC.

President G. W. Flint:

Sir: — The work in Grove Cottage has been carried on during the past year under the system of previous years; the young ladies doing the entire work in the cottage with the exception of the cooking. Each young lady has one room besides her own to keep in order, and this teaches her to feel a certain responsibility in the care of the cottage and gives her a pride in helping to make her College home an attractive one.

When College closed last June we had fourteen young ladies, one less than when the year opened. During the winter term sixteen young ladies lived in the cottage; two of these were day students during the fall and spring term.

I think it unnecessary to say anything about the rules that we have for the young ladies, as we have only those that are necessary in an institution of this description.

The social life in our College is a very important feature, and one that takes as much thought and time as any, and the cottage might be termed the center of all sociality in the College, for it is here that the young men are received by the young ladies Friday evening for a short time, and here that our monthly receptions are held, on the third Friday evening of

every month. The meeting of the young men and young women in a social way, we believe, is an excellent thing for both. It gives the young lady confidence when in a public gathering, and teaches her to entertain and make an evening pass pleasantly for others.

During the first few weeks of the winter term our regular routine of work was very much interrupted by the appearance of la grippe, and more than half of the young ladies were victims of this epidemic, but aside from that there has been no serious sickness in the cottage during the whole year.

Sixteen young ladies are in the cottage this year, and three more are expected at the beginning of the winter term.

Music. — Any student wishing to take piano lessons can do so without extra charge, except one dollar each term for the use of the piano. Last year thirty pupils took piano lessons, making fifteen hours teaching, as each pupil had a half-hour lesson. One recital was given during the year by the piano students. This recital was given in the parlor at Grove Cottage, and all the College faculty and students were invited.

Playing before this audience gives the student more confidence in playing before others. All students are required to practice not less than one hour each day, and they are marked on their practicing. This year I am giving twenty-five half-hour lessons each week, and, although the number taking lessons is a little less than last year, I am very glad to be able to state that the standard of the work done is higher than in any previous year. November 28th, the students gave a public recital, at which some of Mendelssohn's compositions were played, and a brief sketch of his life and work was given.

With the amount of time that students have to put on their music we do not hope to make concert performers, but we do hope to teach them to play well enough to make their homes attractive, and to learn that all-important lesson of making life more cheerful through the influence of music.

Sight Singing. — A course in sight singing is given to the Freshman class each year. Singing is required for one hour each week during fall and winter terms, and is optional during the spring term. We use Cole's system of sight singing, and begin at the beginning of music, teaching the value of notes and the formation of the scales. Also a little of the theory of music is taught, aside from the singing.

Respectfully submitted,

LULU GRIGGS LINCOLN,

Lady Principal and Instructor in Music.

REPORT OF THE VETERINARY DEPARTMENT.

President G. W. Flint:

Sir: — I have the honor to submit the following report for the year ending December 31, 1899.

Human Anatomy and Physiology. — Instruction in these subjects is given during the spring term of the Sophomore year, and includes a study of the animal cell, the unity of structure, the structure of the various tissues and organs of the body, and their functions, and the various influences that promote their healthy development.

Martin's Human Body is used as a text-book and is supplemented by lectures. The work is illustrated by anatomical specimens, a skeleton, and an azoux manikin, which is dissectible, and further by laboratory practice.

Veterinary Science. — Instruction in this subject is given by lectures during the fall and winter terms of the Senior year. The work comprises veterinary anatomy and the general principles underlying disease and its treatment. The common diseases of stock are discussed and the treatment given. Special attention is given to minor surgery, the treatment of wounds, veterinary obstetrics, unsoundness, hygiene, good nursing, and the use of domestic remedies. It is intended to make this course as practical as possible. Sick and injured

animals are brought to the attention of the class whenever possible.

The means of illustration are a collection of veterinary specimens, showing healthy and diseased structures, an azoux horsikin, which is dissectible. The students also dissect a horse. Practical instruction in the care, " handling," harnessing, and driving of horses is given. The young ladies in the Senior class are also instructed in the practical work of harnessing, " hitching up," driving, and tying of horses.

Bacteriology. — In the spring, one term's work in Bacteriology is given the Senior class. The general principles of Bacteriology are given, the relation of bacteria to decomposition, fermentation, contagious and infectious diseases, and to everyday life.

Instruction is given largely by laboratory practice. The students sterilize instruments, make culture media, isolate and grow bacteria, stain, mount, and study the same.

In addition to my classwork I have charge of the horse barn, containing nine horses, six of which belong to the College. To this department also is assigned the care of the horses, hauling of College freight, express, and passengers, letting horses to employes of the College, and furnishing horses for use in the Horticultural Department.

I have also treated all sick animals belonging to the College. During the present college year I have been chairman of the faculty committee on " good order," which has investigated and recommended to the faculty cases needing discipline. I have also looked after the health of the students.

In addition to my College work I have delivered about thirty addresses before granges, institutes, or other farmers' meetings in the State.

Respectfully submitted,

NELSON S. MAYO,

Professor of Anatomy and Physiology, and Veterinary Science.

REPORT OF THE PREPARATORY DEPARTMENT.

President G. W. Flint:

SIR: — Having assumed my duties September 1, 1899, this report must necessarily be confined to the work of the fall term.

Preparatory Work. — The course of study remains practically the same as outlined in the report of my predecessor, the work naturally adapting itself, and leading up to the studies of the first year in the regular College course. Five hours a week are given to Arithmetic, this being the study in which most of the students were found deficient. Four hours each are given to English and United States History. Montgomery's Leading Facts in American History has been substituted for the former text-book, and events in their natural order are studied and discussed with reference to their bearing on present day problems and conditions. Original compositions required in the study of English are largely on historical subjects, with the purpose of encouraging collateral reading and research on the part of the individual students.

Physical Education. — Owing to the size and location of the gymnasium the opportunity for education of the body, through the intelligent use of regular and systematic exercise, is limited to the young women of the College. The young men have as a substitute military drill. For reasons stated in the last report of Mr. Ballou, this is but a poor substitute, when weather conditions are such as to limit opportunities for outside work or play. I would respectfully urge the necessity for providing some facilities, not only for indoor drill, but for a thorough course in physical exercise, believing in common with the majority of educators who have tried the experiment, that it will result in turning out better students and better men.

The young women give three hours a week to physical work, consisting of fancy marching, free work, wand and dumbbell drills, and some light apparatus work. In order to

vary and make the work more attractive, gymnastic games have been introduced, and have been much enjoyed by all. The class, which completely fills the floor space, will be divided for one period during the winter term, thus allowing the introduction of more advanced work for the Senior classes. Some additions to the equipment, including a vaulting horse and springboard, were made at the beginning of last term. The work is planned to give the following results: first, to tone and strengthen the heart, lungs, nerves, digestive system, and other vital organs; second, to correct errors of function, poise, and movement; third, to give strength, endurance, grace, agility, and muscular control; in fact, to do for the body what mental education does for the mind: develop, strengthen, harmonize, intensify, and place under intelligent control of the will all the faculties of the body.

Athletics. — Attention to the football team was given throughout the season. As a result of proper preparation on the part of the students, and the exclusion of men physically incapable of playing the game, no accident worthy of note occurred. A pressing need in connection with athletics is a common dressing-room with proper bathing facilities, for the use of the various teams and their visiting opponents. At present the men are obliged to dress in their respective rooms, to the neatness and sanitary condition of which their soiled and sweaty uniforms do not add.

Respectfully submitted,
THOMAS D. KNOWLES,
Instructor in Preparatory Department.

REPORT OF THE LIBRARIAN.

President G. W. Flint:

Sir: — During the past year the work of the library has gone on in much the same manner as that reported in the two

years preceding this. Few important changes have been made. We were again disappointed in receiving no appropriation from the Legislature for a library building, the need of which grows daily more apparent as new books come in to crowd our already well-filled shelves. However, it is for the future welfare of the institution that, while we have available funds for the purchase of books, our library should grow as rapidly as possible; but it is a matter of only a short time when, unless a building is provided, or an addition made to our present quarters, it will be necessary to remove a part of the books to the laboratories and recitation rooms in which their subjects are studied. This seems an unwise step, for the danger of losing books would be made much greater if they were scattered in different rooms, and the working value of our library would be greatly impaired if the material on every subject could not be accessible to all.

We sincerely hope it will never be necessary to resort to this method, but have faith to believe that the commonwealth of Connecticut at its next General Assembly will not overlook our crying need. As nearly all the space in the main book-room was occupied, a new stack was placed in the reading-room last summer, and all the agricultural reports and bulletins of experiment stations have been moved there and classified, thus leaving some space for expanding the classification of the general library, but this has nearly all been used now, so that more shelves will soon have to be placed in the reading-room and other classes of books removed to them. The reading-room is still well patronized, and our students are fortunate in having so fine and varied a selection of periodicals for their use. Their appreciation is shown by the quiet and studious manner in which nearly all conduct themselves while in the library and reading-room. A marked improvement is shown in this respect during the past term, which is a source of much gratification to the librarian. We have continued

binding our more important periodicals, and have also made some purchases to complete sets of magazines, so that our periodical alcove is now quite valuable, but there are still many additions that should be made in this direction.

On December 1, 1899, our accession books recorded 7,409 titles, showing a gain of 857 volumes during the year, a much smaller number than was added in the preceding year; the list, however, includes several sets of expensive scientific works, so that nearly the same amount of money has been expended for new books as in 1898.

A new method has been adopted for the selection of books to be purchased. Printed slips are distributed among the members of the faculty to be filled out with the titles of books deemed desirable by each instructor for use in his department. In this way the library is being built up symmetrically and keeps in touch with each department of instruction in the College.

Respectfully submitted,
JESSE SPENCER BOWEN,
Librarian.

REPORT OF THE BOARDING DEPARTMENT.

President G. W. Flint:

Sir: — The transition from a lifetime of somewhat intense devotion to agriculture, and of the constant responsibility of directing the labor of others, to my present position, and to the performance of duties new and unfamiliar, suggests the propriety of making my report brief and only suggestive.

The apartments for storage I found both inconvenient and insufficient, and at once planned for their improvement and enlargement. All supplies are now stored in the basement, in close proximity to the kitchen, and are safe from disturbance

or loss. The kitchen has been greatly enlarged by the removal to Grove Cottage of the equipments of the Department of Domestic Science. This affords ample room for the comfort and convenience of those whose duties require their attention during most of the day.

This department has also been greatly improved by the purchase of utensils to replace those long in use and much worn. The large basement, for years the common receptacle for the cast-off implements and utensils of the entire building, has been relieved from its useless furnishings, and fully renovated by the application of paint to the wood, and of kalsomine to the masonry, giving it an air of neatness and an odor of healthfulness.

With these changes, the present facilities are equal to all the present demands of the culinary department.

Great care is exercised in the purchase of supplies for the table, the aim being to combine economy and quality within the limits of a generous restriction. Also in the preparation of the food there is always an abundant supply and the most appetizing variety that experience and skill can suggest. This department deserves the commendation it receives from students and employes.

The dining-room is fully equipped with the necessaries of a well-provided table, but is lacking in capacity. Its present condition is a menace to good order and gentlemanly manners, and no other need of the department is more urgent than that of more capacious dining-halls.

At the beginning of the present College year the price of board was fixed at two dollars and seventy-five cents per week, instead of its variable cost, as heretofore. This allows for a generous supply and a good quality of food, but for no negligence in its purchase, or waste in its use.

Some of the duties formerly included in this department have been transferred to others. Among them are the care

of the students' rooms and the dispensing of medicines. The duties that remain, involving but little actual labor, are still heavy with responsibilities and obligations. They were assumed as an experiment, and the outcome is still in the future.

Meanwhile such ability as I have shall be devoted to their faithful discharge.

Respectfully submitted,

LUCIUS P. CHAMBERLAIN,

Steward.

ESTIMATED INVENTORY OF PROPERTY ON HAND.

CHEMICAL LABORATORY.

Chemical apparatus,	$350 00
Reagent and other bottles,	125 00
Chemicals on hand,	200 00
Physical apparatus,	1,500 00
Photographic apparatus,	175 00
Chemical balances,	225 00
Typewriter,	60 00
Office furniture,	30 00
	$2,665 00

MATHEMATICAL DEPARTMENT.

Engineering instruments,	$429 50
Mathematical models,	28 00
Free-hand drawing supplies,	45 10
	$502 60

MILITARY AND BOTANICAL DEPARTMENT.

Military equipment,	$676 25
Botanical equipment,	182 50
Dormitory equipment,	501 75
	$1,360 50

NATURAL HISTORY DEPARTMENT.

Compound microscopes,	$640 00
Dissecting microscopes,	150 00
Turntables,	16 00
Museum collections,	655 00
Miscellaneous appliances,	75 00
	$1,536 00

MUSIC DEPARTMENT.

Two grand pianos,	$1,000 00
Two upright pianos,	700 00
	$1,700 00

VETERINARY DEPARTMENT.

Apparatus and instruments,	$1,506 75
Bacteriology apparatus and supplies,	275 25
Horses,	380 00
Wagons and sleighs,	425 00
Harness,	119 50
Feed on hand,	245 00
Miscellaneous stock,	59 25
	$3,010 75

MECHANICAL DEPARTMENT.

Carpenter's shop,	$560 00
Iron shop,	385 00
Drawing-room,	50 00
	$995 00

HORTICULTURAL DEPARTMENT.

Tools,	$403 75
Greenhouse stock,	159 05
Wagon scales,	150 00
Fruits and vegetables,	23 50
	$736 30

BOARDING HALL.

Dining-room furniture,	$279 04
Table linen,	85 25
Kitchen utensils,	284 80
	$636 02

CHAMBER OUTFIT.

Furniture,	$322 40
Bed linen,	85 25
Mattresses and pillows,	127 50
Towels, etc.,	30 49
Curtains and hangings,	20 20
Carpets and mattings,	37 75
Bowls and pitchers,	13 50
On hand in storeroom,	90 00
	$736 09

GROVE COTTAGE.

Domestic science equipment,	$600 00
Boarding department,	450 00
Furnishings,	1,000 00
	$2,050.00

FARM MACHINERY, TOOLS, LIVE STOCK, FEED, AND FARM PRODUCTS ON HAND DECEMBER 1, 1900.

Farm machinery and tools,	$1,032 50
1 pair working oxen,	150 00
1 pair heavy farm horses,	250 00
1 pair light farm horses,	200 00
1 driving horse,	150 00
10 thoroughbred cows,	1,000 00

6 thoroughbred heifers,	360 00
4 thoroughbred bulls,	400 00
1 thoroughbred yearling heifer,	25 00
3 thoroughbred calves,	45 00
14 grade cows,	560 00
1 grade yearling heifer,	20 00
6 grade calves,	25 00
3 thoroughbred boars,	60 00
5 thoroughbred breeding sows,	75 00
6 shoats,	40 00
29 pigs,	58 00
32 tons of hay,	352 00
8 tons swamp hay,	56 00
2 tons corn stover,	12 00
125 tons corn silage,	313 00
50 bushels corn,	25 00
900 bushels oats,	315 00
200 bushels turnips,	40 00
700 bushels potatoes,	350 00
1,200 pounds squash,	18 00
19 tons wheat bran,	332 50
5 tons wheat middlings,	95 00
10 tons gluten meal,	240 00
5 tons cotton-seed meal,	125 00
1 ton O. P. linseed meal,	27 00
	$6,751 00

DAIRY DEPARTMENT.

Separators,	$1,100 00
Churns and butter-workers,	92 00
Vats,	285 00
Babcock testers,	86 50
Scales and balances,	69 00
Utensils,	68 30
Cooler and sterilizer,	23 00
Cooley creamer,	20 00
Engine and boiler,	300 00
Supplies,	93 41
	$2,137 21

POULTRY DEPARTMENT.

Stock and supplies on hand,	$185 80

EQUIPMENT.

Incubators and fountains,	$80 00
Apparatus and tools,	66 85
	$146 85

VALUE OF YOUNG STOCK.

151 Thoroughbred fowls,	$235 00
Cross-breeds and miscellaneous,	167 45
	$402 45

VALUE OF OLD STOCK.

Common fowls,	$98 00
Minorcas, Leghorns, and Brahmas,	45 50
Wyandotte, Plymouth Rock, and others,	59 00
	$202 50

SALES OF POULTRY PRODUCTS.

March 1st to August 1st,	$122 65
September,	24 92
October,	35 53
November,	56 61
	$239 71

TREASURER'S REPORT.

H. C. MILES, *Treasurer*,
In account with THE CONNECTICUT AGRICULTURAL COLLEGE.

STATE FUNDS.

RECEIPTS AND DISBURSEMENTS.

Receipts.

1898.			
Sept. 30.	By balance of account,		$1,386.24
Oct. 4.	By Cash Comptroller,		3,750.00
Oct. 18.	" Use of telephone,		9.50
Nov. 7.	" Sale of horse,		80.00
Nov. 8.	" A. B. Peebles, rent of cottage,		37.50
Dec. 14.	" State Treasurer, from Morrill Fund,		7,019.84
Dec. 21.	" B. F. Koons,		2,900.68
Dec. 20.	" G. W. Flint,		100.00
Dec. 20.	" A. H. Freeman,		6.00
1899.			
Jan. 7.	" Comptroller,		3,750.00
Jan. 21.	" Use of telephone,		10.75
April 4.	" Use of telephone,		11.25
April 4.	" Comptroller,		3,750.00
April 5.	" Storrs Agricultural Experiment Station,		112.41
April 8.	" G. W. Flint,		3,000.00
July 6.	" Comptroller,		3,750.00
July 29.	" Use of telephone,		10.50
Aug. 8.	" G. W. Flint,		3,500.00
Sept. 30.	" E. M. Tilden,		12.00
	"		.19
	" Ratcliffe Hicks Prize Fund,		60.00—$33,256.86

CLASSIFICATION OF EXPENSES FOR FISCAL YEAR, OCT. 1, 1898, TO SEPT. 30, 1899.

Disbursements.

Hicks Prize Fund Prizes,	$50.00
Cottages Nos. 2 and 3, balance of construction,	1,875.79
Medicines,	49.41
Salaries,	451.96
General college equipment,	506.96
Care, renovation, and repair of buildings,	3,069.95
Insurance,	528.15
Fuel,	1,812.30
Piano,	250.00
Tuning pianos,	14.00
Pew rentals,	366.69
Commencement expenses,	48.15
Permanent improvements to grounds,	266.12
Care of grounds,	101.68
Miscellaneous expenses,	172.75
Repairs to military equipment,	1.00
Military supplies,	6.00
Unclassified freight and express,	440.93
Laundry,	1,050.57
Miscellaneous college supplies,	23.90
Students' text-books, stationery, and supplies,	2,040.33
Telephones,	23.50
Salaries and traveling expenses, Extension Department,	198.22
New books and supplies, Extension Dept.,	129.95
Natural history supplies,	3.76
Apparatus, Domestic Science Department,	27.95
Supplies for chemistry instruction,	17.26
Live stock,	415.50
Main Boarding Department, equipment,	368.15
Main Boarding Department, labor,	1,329.47
Main Boarding Department, supplies,	3,169.46
Grove Cottage Boarding Dept., equipment,	44.96
Grove Cottage Boarding Dept., labor,	213.00
Grove Cottage Boarding Dept., supplies,	773.43
Farm Department, equipment,	43.32
Farm Department, labor,	2,143.77
Farm Department, supplies,	504.35

Farm Department, blacksmithing,		95.65
Farm and Dairy Departments, feed,		1,655.90
Dairy Department, labor,		160.46
Dairy Department, supplies,		100.60
Dairy Department, butter purchased,		254.24
Dairy Department, milk purchased,		393.61
Poultry Department, supplies,		24.20
Horticultural Department, labor,		497.06
Horticultural Department, supplies,		282.62
Horticultural Department, equipment,		54.00
Horsebarn Department, equipment,		39.09
Horsebarn Department, repairs to equipment,		46.90
Horsebarn Department, labor,		249.46
Horsebarn Department, supplies,		76.85
Horsebarn Department, blacksmithing,		38.86
Balance undisbursed, September 30, 1899:		
State Fund,	$6,719.67	
Hicks Prize Fund,	35.00—	6,754.67—$33,256.86

MILFORD, CONN., Feb. 15, 1900.

This certifies that we have examined the accounts of Henry C. Miles as Treasurer of The Connecticut Agricultural College, for the fiscal year ending September 30, 1899, compared them with the vouchers, and found them correct. The balance in the hands of the Treasurer at the end of the fiscal year was six thousand seven hundred fifty-four dollars and sixty-seven cents ($6,754.67).

D. WARD NORTHROP,
WALTER A. RILEY,
Auditors of Public Accounts.

MORRILL FUND (UNITED STATES GOVERNMENT GRANT) OF 1890.

Statement of Receipts and Disbursements of Morrill Fund, so called (United States Government Grant of 1890), for the fiscal year ending September 30, 1899, Henry C. Miles, Treasurer.

The Federal Act of 1890 prescribes that this fund is "to be applied only to instruction in Agriculture, the mechanic arts, the English language, and the various branches of mathematical, physical, natural, and economic science, with special reference to their application in the industries of life, and to the facilities for such instruction."

The expenditure of any portion of these funds for the purchase, erection, preservation, or repair of any building or buildings under

any pretense whatever is specifically prohibited by the Act (section 3) — and the purchase of land is not allowable (decision of Assistant Attorney-General of United States, March, 1891).

Receipts.

Balance of Fund undisbursed September 30, 1898,	$12,695.57	
Annual Federal Appropriation, received from Treasurer of Connecticut,	24,000.00	
Balance of previous annual Federal appropriation, less $1,000, still in the custody of Treasurer of Connecticut,	19,170.53	
Received interest,	440.00	
Reimbursement from State Fund of amount disallowed by Department of Interior, July, 1899,	60.00	$56,366.10

Disbursements.

Disbursements made in accordance with the provisions of the Federal Act of 1890 and subsequent rulings of the Department of the Interior for salaries of instructors and facilities for instruction, as follows:

1898.		
November,	$2,027.86	
December,	1,501.19	
1899.		
January,	1,871.30	
February,	2,003.51	
March,	2,119.74	
April,	1,517.32	
May,	1,782.26	
June,	3,034.55	
August,	1,636.26	
September,	4,240.80	
Reimbursement made to State Fund to return amounts paid from said State Fund which could have been paid from this fund,	7,019.84	
Balance of fund undisbursed September 30, 1899,	27,611.47	$56,366.10

MILFORD, CONN., Feb. 15, 1900.

This certifies that we have examined the accounts of Henry C. Miles, Treasurer of The Connecticut Agricultural College, relating to the Morrill Fund, for the fiscal year ending September 30, 1899, compared them with the vouchers, and found them correct. The balance of said Morrill Fund in the hands of the Treasurer at the end of the year was twenty-seven thousand six hundred and eleven dollars and forty-seven cents ($27,611.47).

D. WARD NORTHROP,
WALTER A. RILEY,
Auditors of Public Accounts.

LAND GRANT FUND (UNITED STATES GOVERNMENT GRANT) OF 1862.

One of the conditions in the Act granting this fund provides that "No portion of said fund, nor the interest thereon, shall be applied, directly or indirectly, under any pretense whatever, to the purchase, erection, preservation, or repair of any building or buildings."

Receipts.

1898.			
Oct. 1.	By balance of account,		$19,687.29
Oct. 4.	By Cash State Treasurer,		4,112.95
1899.			
Feb. 28.		Interest,	160.00
March 4.		State Treasurer,	2,600.00
Oct. 2.		Interest,	135.00—$26,695.24

Classification of the expenses from the Land Grant Fund (United States Government Grant) of 1862, for the fiscal year, Oct. 1, 1898, to Sept. 30, 1899:

Disbursements.

Salaries of officers,	$2,549.98
Salaries of instructors,	3,222.79
Salaries of employes,	648.86
Traveling expenses,	930.75
Advertising, including catalogues, etc.,	759.29
Printing,	129.84
Postage,	130.19
Military supplies,	460.17
Repairs to local telephones,	85.81
Fuel,	1,573.39
Expense, attending at fairs,	45.21

Telephone rentals and charges,	166.48	
Unclassified freight and express,	18.51	
Carrying mail,	8.28	
Expense of classification of accounts,	100.00	
Telegrams,	.86	
Legal expenses,	500.00	
Furniture and fixtures,	76.01	
Stationery, books of account, and office supplies,	406.74	
Association of American Agricultural Colleges and Experiment Stations,	10.00	
Commencement expenses,	61.00	
Miscellaneous expenses,	51.74	
	$11,935.90	
Balance undisbursed September 30, 1899,	14,759.34	$26,695.24

MILFORD, CONN., Feb. 15, 1900.

This certifies that we have examined the accounts of Henry C. Miles, Treasurer of The Connecticut Agricultural College, relating to the Land Grant Fund for the fiscal year ending September 30, 1899, compared them with the vouchers, and found them correct. The balance of said Land Grant Fund in the hands of the Treasurer at the end of the year was fourteen thousand seven hundred fifty-nine dollars and thirty-four cents ($14,759.34).

D. WARD NORTHROP,
WALTER A. RILEY,
Auditors of Public Accounts.

Amounts paid for salaries, not less than $450 to any individual, from the Morrill Fund (United States Government Grant of 1890):

B. F. Koons,	$1,900.00
A. B. Peebles,	1,900.00
A. G. Gulley,	1,900.00
R. W. Stimson,	1,600.00
N. S. Mayo,	1,600.00
C. A. Wheeler,	1,200.00
H. S. Patterson,	1,100.00
H. A. Ballou,	1,000.00
C. S. Phelps, *one-half salary,	950.00
C. L. Beach,	900.00
Lucretia J. Barber,	710.00
Maude K. Wheeler,	700.00
Josie B. Ballou,	500.00

* Same amount paid by Storrs Experiment Station.

Amounts paid for salaries, not less than $450 to any individual, from the Land Grant Fund (United States Government Grant of 1862):

Geo. W. Flint,	$2,000.00
Theodore S. Gold,	*450.00
Henry C. Miles,	525.00
L. P. Chamberlain,	950.00
Jessie S. Bowen,	600.00
Lulie G. Lincoln,	700.00
W. A. Warren,	480.00

* $50 from Experiment Station.

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CATALOGUE

OF THE

OFFICERS AND STUDENTS

OF THE

CONNECTICUT AGRICULTURAL COLLEGE

STORRS, CONNECTICUT

Courses of Study and General Information



1899-1900.

"He that maketh two ears of corn, or two blades of grass, to grow upon a spot of ground where only one grew before, deserves better of mankind, and does more essential service to his country, than the whole race of politicians put together."—DEAN SWIFT.

HARTFORD, CONN.
Press of The Case, Lockwood & Brainard Company
1900

BOARD OF TRUSTEES.

His Excellency Governor George E. Lounsbury,
President, *ex officio.*

Hon. Wm. E. Simonds, Vice-President.

Appointed by the Senate.

Term Expires in 1901.

William E. Simonds,	Canton,	Hartford County.
Theodore S. Gold,	West Cornwall,	Litchfield County.
Stephen O. Bowen,	Eastford,	Windham County.

Term Expires in 1903.

E. Stevens Henry,	Rockville,	Tolland County.
William D. Holman,	West Willington,	Tolland County.
George A. Hopson,	East Wallingford,	New Haven County.

Elected by the Alumni.

Martin M. Frisbie,	Southington,	Hartford County.

Elected by the Board of Agriculture.

Term Expires in 1900.

Edmund Halladay,	Suffield,	Hartford County.

Ex Officio, Director of The Connecticut Experiment Station.

Edward H. Jenkins,	New Haven,	New Haven County.

EXECUTIVE COMMITTEE.

THEODORE S. GOLD,
STEPHEN O. BOWEN,
WILLIAM E. SIMONDS.

FARM COMMITTEE.

E. STEVENS HENRY,
EDMUND HALLADAY,
WILLIAM E. SIMONDS,
CHARLES S. PHELPS.

COMMITTEE ON HORTICULTURE.

MARTIN M. FRISBIE,
GEORGE A. HOPSON,
ALFRED G. GULLEY.

AUDITORS OF ACCOUNTS.

GEORGE A. HOPSON,
MARTIN M. FRISBIE.

SECRETARY OF THE BOARD.

THEODORE S. GOLD.

TREASURER.

WILLIAM D. HOLMAN.

FACULTY.

GEORGE W. FLINT, A.M.,
President.

BENJAMIN F. KOONS, PH.D.,
Professor of Political Science, Zoölogy, Geology, and Entomology.

CHARLES S. PHELPS, B.S.,
Professor of Agricultural Science.

ARTHUR B. PEEBLES, M.S.,
Professor of Chemistry and Physics.

NELSON S. MAYO, M.S., D.V.M.,
Professor of Anatomy, Physiology, and Veterinary Science.

ALFRED G. GULLEY, M.S.,
Professor of Horticultural Science.

REV. RUFUS W. STIMSON, M.A., B.D.,
Professor of Rhetoric, Ethics, Elocution, and English Literature.

CHARLES A. WHEELER, A.B.,
Professor of Mathematics, History, and Free-Hand Drawing.

WILLIAM A. STOCKING, JR., B.S.A.,
Farm Superintendent and Instructor in Agriculture.

CHARLES L. BEACH, B.S.,
Instructor in Dairying and Cattle Breeding.

HENRY A. BALLOU, B.S.,
Instructor in Botany and Military Science.

HENRY S. PATTERSON (Master Mechanic),
Instructor in Wood and Iron Work and Mechanical Drawing.

ALBERT C. GILBERT, B.A.,
Assistant in Chemistry and Physics.

THOMAS D. KNOWLES,
Instructor in Physical Culture, English, Mathematics, and History.

RODERICK DALLAS,
Instructor in Poultry Culture.

CHARLES E. MYERS,
Chief Clerk and Instructor in Book-Keeping and Business Methods.

MISS LUCRETIA J. BARBER,
Instructor in English and Elocution.

MRS. MAUDE K. WHEELER,
Instructor in Domestic Science.

MISS LULU G. LINCOLN,
Lady Principal.

LUCIUS P. CHAMBERLAIN,
College Steward.

CHARLES E. MYERS,
Secretary of the Faculty.

COMMITTEE ON COURSES OF STUDY.

CHARLES S. PHELPS,
ARTHUR B. PEEBLES,
CHARLES A. WHEELER.

COMMITTEE ON GOOD ORDER.

NELSON S. MAYO,
HENRY S. PATTERSON,
HENRY A. BALLOU.

THE STORRS EXPERIMENT STATION.

(Storrs, Conn.)

OFFICERS OF THE STATION.

Station Staff.

WILBUR O. ATWATER, PH.D.,
Director.

CHARLES S. PHELPS, B.S.,
Vice-Director and Agriculturist.

FRANCIS G. BENEDICT, PH.D.,
Professor of Chemistry.

PHILIP B. HAWK, B.S.,
Assistant Chemist.

HERBERT KIRKPATRICK, B.A.,
Assistant Agriculturist.

FRANK E. SINGLETON, B.S.,
Secretary.

EXECUTIVE COMMITTEE.

THEODORE S. GOLD,
STEPHEN O. BOWEN,
GEORGE W. FLINT,
(President of College).

WILLIAM D. HOLMAN,
Treasurer.

CALENDAR

1899—1900

"He who knows most, grieves most for wasted time."—DANTE.

The college year contains forty-two weeks, divided into four terms of six, thirteen, twelve, and eleven weeks respectively.

FALL TERM, 1899

Monday,	September 18,	Entrance Examinations.
Tuesday,	September 19,	Fall Term begins.
Tuesday,	October 17,	Meeting of the Board of Trustees.
Friday,	November 17,	Freshman Rhetoricals.
Tuesday,	November 28,	Piano Recital.
Wednesday,	November 30,	Thanksgiving Recess.
Sunday,	December 3,	
Friday,	December 8,	Sophomore Rhetoricals.
Friday,	December 15,	Junior Rhetoricals.
Monday,	December 18,	Term Examinations.
Tuesday,	December 19,	
Wednesday,	December 20,	
Wednesday,	December 20,	Fall Term ends.

Winter Vacation, Twelve Days

WINTER TERM, 1900

Tuesday,	January 2,	Entrance Examinations.
Wednesday,	January 3,	Winter Term begins.
Wednesday,	February 7,	Preparatory Rhetoricals.
Wednesday,	February 14,	Freshman Rhetoricals.
Thursday,	February 22,	Washington's Birthday.
Tuesday,	February 27,	Sophomore Rhetoricals.
Wednesday,	March 14,	Junior Rhetoricals.
Wednesday,	March 21,	Term Examinations.
Thursday,	March 22,	
Friday,	March 23,	
Friday,	March 23,	Winter Term ends.

Spring Vacation, Nine Days

SPRING TERM, 1900

Monday,	Aprli 2,	Entrance Examinations.
Tuesday,	April 3,	Spring Term begins.
Wednesday,	April 11,	Hicks Prize Essays due at 12 o'clock, M.
Wednesday,	May 9,	Preparatory Rhetoricals.
Friday,	May 11,	Hicks Prize Speaking.
Wednesday,	May 16,	Freshman Rhetoricals.
Friday,	May 25,	Sophomore Rhetoricals.
Wednesday,	May 30,	Memorial Day.
Friday,	June 1,	Junior Rhetoricals.
Friday,	June 8,	President's Reception.
Sunday,	June 10,	Baccalaureate Sermon.
Monday,	June 11,	Society Banquets.
Tuesday,	June 12,	Class Day.
Tuesday,	June 12,	Senior Reception.
Wednesday,	June 13,	Meeting of the Board of Trustees.
Wednesday,	June 13,	Commencement.
Wednesday,	June 13,	Commencement Address.
Wednesday,	June 13,	Meeting of the Alumni.
Wednesday,	June 13,	Alumni Reception.
Saturday,	June 16,	Entrance Examinations.

Senior Vacation, Three and Four-sevenths Weeks

SUMMER TERM, 1900

Monday,	July 9,	Summer Term begins.
Friday,	August 17,	Summer Term ends.

Summer Vacation, Thirteen and Four-sevenths Weeks

FALL TERM, 1900

Saturday,	September 15,	Entrance Examinations.
Monday,	September 17,	Fall Term begins.
Monday,	October 1,	Inventories of all Departments.
Tuesday,	October 16,	Meeting of the Board of Trustees.
Thursday,	November 1,	Reports of all Departments.
Friday,	November 23,	Sophomore Rhetoricals.
Wednesday,	November 28,	Thanksgiving Recess.
Sunday,	December 2,	
Friday,	December 14,	Junior Rhetoricals.
Wednesday,	December 19,	Term Examinations.
Thursday,	December 20,	
Friday,	December 21,	
Friday,	December 21,	Fall Term ends.

Winter Vacation, Sixteen Days

WINTER TERM, 1901

Monday,	January 7,	Extrance Examinations.

SPECIAL EXAMINATIONS

1900

Friday,	August 31,	In the Selectmen's Room, City Hall, Danbury.
Friday,	August 31,	In the Council Chamber, City Hall, Norwich.
Friday,	August 31,	At the Experiment Station, N. Haven.
Saturday,	September 1,	In Room 50, Capitol, Hartford.
Saturday,	September 1,	At the College, Storrs. All at 9 A. M.

1899-1900.

"Seize time by the forelock."—PITTACUS.

SEPTEMBER.

S	M	T	W	T	F	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

OCTOBER.

1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

NOVEMBER.

			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30		

DECEMBER.

					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

JANUARY.

	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

FEBRUARY.

				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28			

MARCH.

S	M	T	W	T	F	S
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

APRIL.

1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

MAY.

		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

JUNE.

					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

JULY.

1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

AUGUST.

			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

GENERAL INFORMATION.

THE CONNECTICUT AGRICULTURAL COLLEGE.

"Impartially their talents scan,
Just Education forms the man." — *Gay.*

In the various states composing the Union, the colleges of "Agriculture" and "Mechanic Arts" were founded through an Act of Congress, entitled "An Act donating Public Lands to the several States and Territories, which may provide Colleges for the benefit of Agriculture and the Mechanic Arts."

This Act was approved July 2, 1862. Public land was donated to the amount of 30,000 acres for each Representative in the National Congress.

Connecticut's share returns now an income of five per cent. on an investment of $135,000. The State receiving such benefit shall establish "a College where the leading object shall be, without excluding other scientific and classical studies, and including military tactics, to teach such branches of learning as are related to *agriculture* and the *mechanic arts*, in order to promote the liberal and practical education of the industrial classes in the several pursuits and professions of life."

These land grant colleges, so called, are also supported from the general government by an Act of Congress, passed August 30, 1890, known as the "Morrill Bill," the fund of which now provides for each college $25,000 annually. No buildings of any kind can be constructed from these funds, which are limited to "legitimate college expense," and "instruction and facilities for instruction."

An Agricultural Experiment Station is connected with the

College, and is under control of the Board of Trustees. The object of the Station is to make experiments in things pertaining to agriculture, including dietaries, and is supported by the fund created by the " Hatch Act " of 1887; from this the State obtains annually $15,000, of which the Connecticut Experiment Station, at New Haven, receives $7,500.

NAME.

" What's in a name? That which we call a rose, by any other name would smell as sweet."—*Shakespeare.*

By a special act of the State Legislature of 1893 the State College was established under the name of Storrs Agricultural College. By Act of the Legislature of 1899, Chapter 169, Section I, " The name of the Storrs Agricultural College is hereby changed to that of The Connecticut Agricultural College, and shall be subject to all laws applicable to said Storrs Agricultural College, and the management of said College shall continue as at present until changed by proper authority."

Sec. II. " Whenever a library building shall be erected upon the grounds of said College, such library shall be named the ' Storrs Memorial Library,' and shall bear that name conspicuously, both exteriorly and interiorly."

ALUMNI TRUSTEE.

"Small service is true service."— *Wordsworth.*

Sec. III. " There shall be a Trustee of The Connecticut Agricultural College in addition to those now provided by law, who shall be elected for a term of four years from July first next succeeding his election, by and from the graduates of said institution; the election to be under the supervision of the Trustees for the time being, and to be so conducted that all graduates shall have opportunity to vote therein by signed ballots personally or by letter."

LOCATION.

"Of all that is most beauteous, imaged there
In happier beauty; more pellucid streams,
An ampler ether, a diviner air,
And fields invested with purpureal gleams."— *Wordsworth.*

The State Agricultural College of Connecticut is located on a commanding eminence six hundred feet above sea-level, in an eastern section of the State, noted for its scenic beauty. The young men and women of the State will find here a charming spot, away from the disturbing influences of the larger centers, where they may gain for themselves that preparation for citizenship which the times demand of every citizen. The college station is Eagleville, on the Vermont Central railroad, which connects at Willimantic with the New England division of the Consolidated road. Communication with the College is rendered easy by the long-distance telephone and by telegraph. And when connection is made with Willimantic by "trolley," the situation will be all that could be desired.

BUILDINGS AND EQUIPMENT.

"When we build, let it not be for present use alone; let it be such work,
As we lay stone on stone, that men will say as they look upon the labor
And wrought substances of them, 'See! this our fathers did for us.'"— *Ruskin.*

Main Building. — All the buildings, with one exception, are of wood. The main building was erected in 1890, a two-story structure with a basement, and contains a chapel, President's office, mathematical recitation room, preparatory recitation room, library, reading-room, dining-hall, and steward's rooms on the first floor. The second floor contains a recitation room for English Literature, a Horticultural room, Museum, a room for Botany and Mechanical Drawing, and a Veterinary Science Museum.

Chemical Laboratory. — This building, one story and a half high, is situated northwest of the main building. It is well equipped with modern apparatus, both in its Chemical and Physical appointments, and has convenient apartments for lecture-room work.

Experiment Station. — Northwest of the chemical laboratory is a small structure containing the offices of the Agricultural Experiment Station.

Dormitories. — The east building contains seventeen study rooms, used by the male students of the lower classes, though four of the Senior class chose rooms there for the last year of their course. Instructors C. A. Wheeler and C. L. Beach, with their families, occupy twelve rooms on the first floor of this building for their living apartments. The rooms are all heated by steam. The " New Dormitory " was built in 1890, with a dwelling-house for the President connected at the front. This building is steam heated, and affords a comfortable home for the upper class men.

Grove Cottage. — When co-education became a factor at the State College, a fine, homelike residence was constructed for the purpose. Airy rooms, spacious halls, reception parlors, dining hall, and a gymnasium ; a sewing room for the Domestic Science work, and rooms for the Lady Principal comprise the first and second floors. A fine laboratory room has recently been fitted up in the basement for the Domestic Science cooking school.

Miscellaneous Buildings. — Besides those described, there are three snug dwelling houses for the professors of the College, the horse barn, and barns for the dairy herd. A dairy building has been begun, and rendered suitable for making butter by the latest and most scientific methods; a greenhouse for growing and storing plants.

Buildings Needed. — 1. A machine and carpenter shop for the " Mechanic Arts " department, well equipped with machinery and tools. 2. A Horticultural building with museums and laboratories ; a building sufficiently large for a botanical museum and laboratory in conjunction with it. 3. Inasmuch as the government requires that military science shall be taught

in the land-grant colleges, a drill hall is of paramount importance, especially during that portion of the College year when drilling on the campus is out of the question. This building could be used for an auditorium, a gymnasium, and a variety of purposes directly connected with the physical well-being of all the students. 5. A boarding hall with a well-appointed kitchen above ground, apartments for the steward and his servants, and a large, well-lighted dining-room for both sexes. 6. Dwelling houses with a sufficient capacity to afford comfortable homes for the faculty of the College. 7. A library building with modern appointments for a well-selected and well-arranged library, together with the President's offices and fireproof vaults on the first floor, and the second floor devoted to a Museum of Art, Natural History, Mineralogy, Geology, etc.

EXPENSES.

"There can be no profit, if the outlay exceeds it."—*Plautus.*

The College gives free tuition and room rent. Each room contains a bed, mattress, study table, and chairs. Students are required to furnish bedding, toilet and table linen, lamps, carpets, rugs, and other things which make rooms comfortable and homelike.

The College furnishes fuel, lights, books, and stationery as nearly as possible at cost prices. Board in the "Boys' Hall" is $2.75 a week.

Expenses will vary from $125 a year upwards; but any student, ambitious and economical, may reduce his yearly expenditures to a minimum cost.

At the beginning of each term every student rooming in the College buildings is charged $40 in advance to meet his College expenses. Day students, a payment in advance of $10 for books, stationery, etc.

STUDENT LABOR.

"He who would reach the desired goal must, while a boy, suffer and labor much, and bear both heat and cold."—*Horace.*

The College employs students of both sexes and pays them according to their work.

The heads of the different departments superintend the working students. Young men and women who are worthy and faithful can help their parents financially and at the same time learn how to do things pertaining to the farm and the household.

CHURCH ATTENDANCE.

"What greater calamity can fall upon a nation than the loss of worship."—*Emerson.*

All students are required to be present for a short service at the College chapel daily except Saturday and Sunday.

Every student is required to attend the church service on Sunday morning. Voluntary services are held weekly by the Young Men's Christian Association, the Young Women's Christian Association, and also by the Christian Endeavor Society.

The Second Congregational Church of Storrs has assigned one-fourth of its seating capacity for the exclusive use of the College students.

ENTRANCE REQUIREMENTS.

"He who binds his soul to knowledge, steals the key of heaven."—*Willis.*

All applicants for admission to The Connecticut Agricultural College must be citizens of Connecticut, and at least fifteen years of age.

Satisfactory testimonials in respect of good character and previous scholarship from a former teacher, pastor, or neighbor will be required of each candidate.

Candidates may enter an advanced class if, on examination, they are found qualified.

New classes are formed at the beginning of the College year, but students may be admitted at any time by special examination.

Candidates may be admitted on certificate from accredited High Schools, at the discretion of the faculty, if the previous High School work is equivalent to that done by the lower College classes.

Those who enter College under conditions will be required to work off such conditions before advancing to the next year's course.

All candidates for the Short Dairy Course, during the winter term, will be admitted without examination.

A good preparation enhances the College course tenfold. The following subjects will be required for entrance to the Freshman class in 1900:

Arithmetic. — A thorough knowledge of Fractions, Denominate Numbers, Mensuration, Percentage, Discount, Interest, Bonds and Stocks, Square and Cube Root.

Geography. — What is usually comprised in a common school course.

History. — Montgomery's Leading Facts in American History or its equivalent.

English. — Grammar. A fair acquaintance with the parts of speech, the construction of sentences, punctuation, and the use of capitals, and the ability to write correctly.

Reading. — The course prescribed by the New England colleges is recommended to all candidates for the State College.

All examinations must be written, in which the applicant's orthography will be carefully noted.

DEPORTMENT.

"A man should *be* upright, not be *kept* upright."— *Marcus Aurelius.*

The State College was founded for the purpose of providing the fullest and best opportunity for the "Industrial Classes" to secure a practical education. And all students enjoying the

advantages thus afforded should realize fully that to forego these privileges by misuse or abuse is a matter of very serious concern to themselves.

Absence from College invariably interrupts the continuity of the student's work and diverts his attention from the main object for which he attends College. Therefore, parents and guardians are courteously requested not to ask that their sons and daughters be permitted to leave College in term time, except for urgent reasons.

An excuse for leave of absence from College to be valid must be signed by the class officers and delivered to the President of the College, and the student thus excused will be required to make up all deficiencies in study and drill caused by his absence.

All questions of change from the regular course of study, or of dropping studies, shall be referred to the committee on courses of study, and through them to the faculty.

Unexcused absences from College, church, or chapel will be accounted equivalent to two demerits on deportment.

PROMOTION.

"Ignorance is the curse of God,
Knowledge the wing wherewith we fly to heaven."—*Shakespeare.*

Instructors keep a daily record of the standing of each student, based upon a scale of one hundred. The standard for the four grades is sixty, sixty-five, seventy, and seventy-five per cent. for final grade in any subject.

The final grade is determined by averaging three times the term marks plus the test marks, if any, plus the examination marks, if any.

Students who attain in any subject an average term mark of eighty in the Freshman class, eighty-five in the Sophomore class, ninety in the Junior class, and ninety-five in the Senior class shall be exempt from examination in that subject.

Students absent from one-tenth the entire recitations in any subject shall take a special examination in such subject or subjects after due notice has been given.

A failure in two branches will allow a student to pass with the condition that the deficiency be satisfactorily made up before the end of the succeeding term.

A student failing in more than two studies shall drop back to the next lower class or withdraw.

Students intending to graduate shall make up all deficiencies before the spring term of the Senior year.

No student whose College bills are in arrears shall receive a diploma.

PRIZES.

"The conscious utterance of thought by speech or action, to any end, is art."—*Emerson.*

Students of the Junior and Senior classes may contend for the Ratcliffe Hicks prizes. Those who write for these prizes must deliver their essays, type-written, to the President on or before the second Wednesday in April, and no essay will be received after 12 o'clock noon that day.

Each essay shall contain at least fifteen hundred words, and shall be approved by a committee of the faculty appointed by the President of the College.

Such essays as are not approved shall be returned to the writers, and the successful contestants shall be notified at once, that they may prepare themselves to deliver their essays, the second Friday evening in May, from the chapel rostrum before three judges, who shall decide on the best delivery.

The award shall be determined by the marks both for composition and delivery.

The Ratcliffe Hicks prizes for 1899 were awarded to H. D. Emmons, first, $30; and the second, of $20, to E. F. Manchester.

Committee of award on English composition, Professor H. R. Monteith, Farmington; Professor F. S. Luther, Trinity College, Hartford, and Professor C. S. Beardslee, Hartford Theological Seminary.

Committee of award on delivery, A. R. Wadsworth, Farmington; Rev. C. F. Stimson, Bridgeport, and Rev. E. A. George, Willimantic.

COURSES OF INSTRUCTION.

"First say to yourself what you would be; and then do what you have to do."—*Epictetus.*

The courses of instruction include class-room work in English and English Literature, Ethics, Mathematics, Physics, Chemistry, Botany, Entomology, Zoology, Geology, Agriculture, Horticulture, Veterinary Science, Domestic Science, and Music; Physical Training in the gymnasium for the young women, and Military Drill for the young men.

The young men of each class, at the beginning of the Senior year, are required to supplement the course with a summer term of six weeks, in order to gain special instruction in certain lines of Agriculture and Horticulture, and in Entomology, which are more available at that season.

ENGLISH.

"Endless are the modes of speech and far
Extends from side to side the field of words."
—*Bryant's Homer's Iliad.*

1. *Preparatory English.* — Four periods a week are given to Preparatory English, including Capitalization, Punctuation, Spelling, Invention, etc.

Mr. Knowles.

2. *Grammar and Elocution.* — The Freshman and Sophomore classes receive instruction four hours a week in English Grammar, and one hour in Elocution. Technical Grammar and Composition are developed together, both by class instruc-

tion and by instruction with individual students, from Sheldon's Advanced Language Lessons and Curry's Vocal Expression.

MISS BARBER.

3. *Rhetoric.* — Junior class, three terms, three hours a week. Text-books used are Waddy's Elements of Composition and Rhetoric, and Hill's Foundations of Rhetoric, with lectures by the instructor. Critical reviews of books and essays are written by the members of the class, and reading is assigned to each student from week to week.

PROF. STIMSON.

4. *Elocution.* — Junior class, three terms, one hour a week, with individual instruction for the technique of delivery. Curry's Vocal Expression is used as a text-book.

PROF. STIMSON.

SENIOR COURSE.

"The man who is fond of books is usually a man of lofty thought and elevated opinions."—*Dawson.*

1. *English Literature.* — Fall and winter terms, three hours a week, and one comprehensive essay, each term. The writing of each student is carefully criticised, with suggestions toward improvement. Introductory lectures on books and reading are given, together with discussions of the masterpieces. The text-books for general study are Brooke's English Literature, Mason's Student's Readings and Questions in English Literature, the Study of English Literature, by Matthews, and George's From Chaucer to Arnold.

PROF. STIMSON.

2. *Elocution.* — Fall term, one hour a week. This course advances from the rudiments of pantomimic training into the more elaborate parts of the language to the eye. In vocal training it continues the cultivation of the language to the ear.

And, with individual students, carries the co-ordination of these two elements of delivery from the lower to the higher forms of address.

PROF. STIMSON.

3. *Senior Addresses.* — Three during the year, with individual work between student and instructor. Usually six weeks' preparation is given to each address, upon such subjects as are of interest to the speaker, and in the line of his work.

PROF. STIMSON.

4. *Extemporaneous Speaking.* — During the winter and spring terms, members of the class are assigned by the instructor to speak impromptu before the student body, on such subjects, as each may be prepared, out of his own experience, or by reading and study.

PROF. STIMSON.

5. *Ethics.* — Spring term, two hours a week. In this branch Ethics is studied as the Science of Conduct. The students choose special topics in ethical fact, and, after careful study, two weeks before Commencement, present, each, a thesis. Janét's Elements of Morals as a text-book forms the basis of class study.

PROF. STIMSON.

HISTORY.

"Examine History, for it is Philosophy teaching by Experience."— *Carlyle.*

1. *American History.* — Three terms, four hours a week. Montgomery's Leading Facts is used in class work, supplemented by current topics and historical research.

MR. KNOWLES.

2. *European History.* — Sophomore and Freshman classes, two hours a week during the fall term, and one hour a week in the winter.

Each student is required to bring to the classroom preparation for discussion of assigned topics, questions on the chief

points of the lesson, and what information he has gleaned from investigation. Adams' New European History and Adams' Mediaeval Civilization are used as text-books.

Mr. Wheeler.

AGRICULTURE.

"Smoothly and lightly the golden seed by the furrow is covered."— *Goethe.*

1. *Agronomy.* — Two terms, four hours a week. Soils are treated in respect of their properties, improvement by tillage, drainage, irrigation, and fertilization. Practical instruction is given in the food value of crops, methods of planting, caring for, and harvesting crops.

Prof. Phelps.

2. *Zootechny.* — Four hours a week. Care is taken to gain a practical knowledge of the principles of feeding, care, and management of live stock.

Prof. Phelps.

3. *Farm Economy.* — Treating of farm management, rural law, business operations relating to the farm, farm machinery, etc. Text-book, Henry's Feeds and Feeding.

Prof. Phelps.

4. *Laboratory Field Work.* — Including all the leading operations of the farm in their season.

Mr. Stocking, *Farm Superintendent.*

5. *Poultry Industry.* — Winter term, with lectures and practice in incubation, artificial rearing, and selecting the best breeds by a scale of points; feeding, and general principles of poultry management. Text-books in use, Beale's Profitable Poultry-keeping, and Breeding and Feeding Poultry for Profit.

Mr. Dallas.

HORTICULTURE AND FLORICULTURE.

"Now every field and every tree is in bloom,
The woods are in full leaf, and the
Year is in its brightest beauty."— *Virgil.*

1. *Pomology.* — Method of raising and preparing fruits for market; the theory and practice of spraying fruit trees. Text-book used, Thomas' American Fruit Culturist.

2. *Landscape Gardening.* — The application of the principles of landscape art. Text-book used, Long's Ornamental Gardening.

PROF. GULLEY.

CHEMISTRY.

"See plastic Nature working to this end,
The single atoms each to other tend,
Attract, attracted to, the next in place
Formed and impelled its neighbor to embrace."— *Pope.*

1. *General Chemistry.* — Winter term, Freshman class, five hours a week. General principles of Chemistry, with experiments in laboratory. The text-book is Williams' Elements of Chemistry.

PROF. PEEBLES.

2. *Inorganic Chemistry.* — Thorp. Prof. Peebles.

3. *Organic Chemistry.* — Remsen. Prof. Peebles.

4. *Qualitative Analysis.* — Lectures. Prof. Peebles.

5. *Quantitative Analysis.* — Government Methods. Prof. Peebles.

6. *Laboratory Chemistry.* — Volumetric Analysis. Prof. Peebles.

7. *Agricultural Chemistry.* — Lectures. Prof. Peebles.

PHYSICS.

"What does Philosophy impart to man but undiscovered wonders."— *White.*

1. *General Physics.* — Fall term, Junior class, four hours a week. The text-books are Bourgougnon's Physical Problems, and Gage's Physical Laboratory.

Fall and winter term, Sophomore class, two hours a week. The text-book is Wentworth and Hill's Text-book of Physics.

PROF. PEEBLES.

2. *Electricity.* — Spring term, Senior class, five hours a week. Special course.

PROF. PEEBLES.

DAIRYING.

"Come, give us a taste of your quality."—*Shakespeare.*

1. *Short Course.* — Designed to meet the wants of those who feel the need of a better preparation in the art of Dairying. Composition of Milk, Condition of Creaming, Milking for Market, Butter Making, Salting, Packing, etc. Lectures on Breeds and Breeding, Heredity, Atavism, Typical Dairy Cows, etc. Text-book used, Milk and Its Products.

MR. BEACH.

2. *College Course.* — Winter term, Junior class, four hours a week, with laboratory work and keeping records of the herd. Text-books, Milk and Its Products, and Outlines of Dairy Bacteriology.

MR. BEACH.

NATURAL HISTORY.

"Come forth into the light of things;
Let Nature be your teacher."—*Wordsworth.*

1. *Entomology.* — Summer term, Senior class. Lectures and field work, collections of destructive insects, study of their habits, ravages, and means of prevention.

PROF. KOONS.

2. *Geology and Mineralogy.* — Fall term, Senior class. General principles of the subject, distribution of life upon the earth, coal beds, peat formation, field work among the rocks. Dana's Text-book of Geology Revised is used for class work.

PROF. KOONS.

3. *Ornithology.* — Summer term, Senior class, one period a week. The study aims at a familiarity with the common birds and their economic relations to man, with museum and field work.

PROF. KOONS.

4. *Zoology.* — Senior year, one term. Lectures with collections of illustrative subjects.

PROF. KOONS.

5. *Cryptogamic Botany.* — Senior class, two terms, six hours per week. Laboratory work, supplemented with lectures, treating of fungus diseases, and the physiology of plants. Text-book used is Campbell's Structural and Systematic Botany.

MR. BALLOU.

6. *Botany.* — Freshman class, three terms, five hours a week. Elements of Structural, Systematic, and Physiological Botany. Students are required to prepare herbariums of fifty native wild plants. Text-books, Kellerman's Elementary Botany, Practical Studies in Botany, and Gray's Manual of Botany.

MR. BALLOU.

7. *Anatomy and Physiology.* — Spring term, Sophomore class, five hours a week. Lectures, with a study of the animal cell, the structures of the various tissues and organs of the body and their functions, and the influence that promotes their healthy development. The text-book is Martin's Human Body.

DR. MAYO.

8. *Veterinary Science.* — Fall and winter terms, Senior class, five hours a week. Lectures in veterinary anatomy, general principles of diseases and their treatment, minor surgery, wounds, veterinary obstetrics, hygienic nursing, and the application of domestic remedies.

DR. MAYO.

9. *Bacteriology.* — Spring term, Senior class, five hours a week. Lectures and laboratory work in general principles, relation of bacteria to decomposition, fermentation, contagious and infectious diseases.

DR. MAYO.

ECONOMICS.

"With malice towards none, with charity for all, with firmness in the right, as God gives us to see the right." — *Lincoln.*

1. *Civics.* — Spring term, Junior class, three hours a week. The fundamental principles of the subject are taught, leading up to the comprehension of the facts which underlie citizenship, the constitution, and laws of the State and nation. Martin's Civil Government is used for class work.

PROF. KOONS.

2. *Political Economy.* — Winter term, Senior class, three hours a week. The main topics are treated, the fundamental principles are emphasized, and the economic questions related to the progress and complex conditions of State and nation are considered. Text-book used is Laughlin's Elements of Political Economy.

PROF. KOONS.

MATHEMATICS.

"Whence is thy learning? Hath thy toil
O'er books consumed the midnight oil?" — *Gay.*

1. *Arithmetic.* — Preparatory class, three terms, five hours a week. Principles of arithmetical computation in business are emphasized, and an effort made to secure a foundation for the study of Algebra. The text-book is Walsh's Grammar School Arithmetic.

MR. KNOWLES.

2. *Algebra.* — Freshman class, three terms, four hours a week. The Fundamental Processes of Algebra, Equations, Roots, Powers, Proportion, Progressions, Binomial Theorem, Logarithms, Permutations and Combinations, etc. The text-book is Well's Essentials of Algebra.

MR. WHEELER.

3. Plane Geometry. — Sophomore class, three terms, four hours a week. Demonstration of theorems, together with practice in plotting and solving original problems, pace-surveying, and hand-leveling. The text-book is Pettee's Plane Geometry.

MR. WHEELER.

4. Solid Geometry. — Fall term, Junior class, three hours a week. Lines, planes, solids, and volumes, and calculation of areas by latitudes and departures. The text-book is Wentworth's Solid Geometry.

MR. WHEELER.

5. Trigonometry. — Winter term, Junior class, three hours a week. Functions of angles, derivation of formulae, solution of right and oblique triangles, and a part of Spherical Trigonometry. The text-book is Wentworth's New Plane and Spherical Trigonometry.

MR. WHEELER.

6. Surveying. — Winter and spring terms, Senior class, five hours a week. Theory and practice, use of instruments, railroad surveys and curves, field work, computing of earthwork excavations. The text-books are Raymond's Plane Surveying, and Searles' Field Engineering.

MR. WHEELER.

MECHANICS.

"In every rank, or great or small,
'Tis industry supports us all."— *Gay.*

1. Carpentry. — Winter term, Junior and Sophomore classes, three hours a week. The care of tools, both grinding and filing, practice in making joints in woodwork, wood-turning, and the construction of useful articles.

MR. PATTERSON.

2. Forge Work. — Winter term, Senior class, six hours a week. The making of chains, chain links, eye bolts, cold chisels, welding, tempering, drawing, upsetting, etc.

MR. PATTERSON.

3. Mechanical Drawing. — Winter term, Junior, Sophomore, and Freshman classes, two hours a week. Problems in dimension drawing, drawings of machinery, architectural drawing, etc.

MR. PATTERSON.

DOMESTIC SCIENCE.

"Cookery is become an art, a noble science."— *Burton.*

1. Cookery. — Fall and winter terms, Sophomore class, two hours a week. Nutritive value of foods, art of serving, cooking of meats, vegetables, bread, pastry; preserving fruits and jellies, pickle making, etc. The text-book is The Boston School-Kitchen Text-Book.

MRS. WHEELER.

2. Domestic Economy. — Senior and Sophomore classes, one period a week. Lectures on Hygiene, Emergencies, Home-nursing, Prevention and Care of Contagious Diseases, Nutrition and Chemistry of Foods.

MRS. WHEELER.

3. Sewing. — Three years, six periods a week. Plain and hand sewing, hemming, stitching, gathering, darning, mending, etc., dress-making, including cutting and fitting.

MRS. WHEELER.

4. Laundering. — Instruction is given in the use of washing powders, starch, bluings, etc., and practice in washing and ironing white and colored clothing, fine fabrics, linens, laces, embroideries, woolens, silks, etc.

MRS. WHEELER.

MUSIC.

"There's music in the singing of the reed;
There's music in the gushing of a rill.
There's music in all things, if men had ears;
Their earth is but an echo of the spheres."— *Byron.*

1. Piano. — Half-hour lessons each week, and practice one hour a day. Instruction books are the National Graded Course, and Wagner's First Instruction.

MISS LINCOLN.

2. Sight-Singing. — Two terms, Freshman class, one hour a week, spring term optional. The value of notes, the formation of scales, and the theory of music. Cole's Sight-singing and Levermore's Academy Song Book are the text-books in use.

MISS LINCOLN.

MILITARY SCIENCE.

"To be prepared for war is one of the most effectual ways of preserving peace."— *Washington.*

Military drill and recitation in military science are compulsory. No student is excused except on a physician's certificate as to his physical disability. The uniform requirements are navy blue cap, coat, and trousers, costing about $14. Absences from drill are made up at such times and in such ways as the commandant may determine.

1. Military Drill. — All classes, three hours a week during the course. Marching, physical exercises, target practice.

MR. BALLOU.

2. Drill Regulations. — Spring term, Junior class, one hour a week. Recitations on U. S. Infantry Drill Regulations.

MR. BALLOU.

EXTENSION DEPARTMENT.

"Human improvement is from within outwards."—*Froude.*

The "Reading Course" has become an important factor among people removed from centers where no libraries exist, and for those who cannot or will not spend time in college for intellectual development. This course rightly begun and persistently followed will prove of great benefit to the State.

COURSE OF STUDY.

FIRST YEAR.

For Women.	*For Men.*
Floriculture.	Agriculture.
Domestic Science.	Agricultural Chemistry.
General Science.	General Science.
Botany.	Botany.

SECOND YEAR.

For Women.	*For Men.*
The Way we did at the Cooking School.	The Principles of Fruit Growing, or Milk and Its Products.
Hygiene and Physiology, or Physical Development.	The Spraying of Plants, or Farmers' Bulletins.
Realm of Nature, Part I.	Realm of Nature, Part I.
The Story of Germ Life.	The Story of Germ Life.

SCHEDULED OUTLINE OF STUDY.

PREPARATORY YEAR.

NOTE.—The numbers refer to the periods per week.

FALL TERM.

Arithmetic,	5
U. S. History,	4
Physical Geography,	2
English,	4
Singing,	1
Military Drill,	3

WINTER TERM.

Arithmetic,	5
U. S. History,	4
Physical Geography,	2
English,	4
Singing,	1
Military Drill,	3
Rhetoricals.	

SPRING TERM.

Arithmetic,	5
U. S. History,	4
English,	4
Physical Geography,	2
Singing,	1
Military Drill,	3
Rhetoricals.	

FRESHMAN YEAR.

FALL TERM.

Algebra,	4
English,	5
Botany,	4
General History,	2
Drawing,	2
Singing,	1
Military Drill,	3
Rhetoricals.	

WINTER TERM.

Algebra,	4
English,	5
Botany,	4
Chemistry,	5
Mechanical Drawing,	2
Singing,	1
Military Drill,	3
Rhetoricals.	

SPRING TERM.

Algebra,	4
English,	5
Botany,	4
Chemistry,	2
Military Drill,	3
Rhetoricals.	

SOPHOMORE YEAR.

FALL TERM.

Geometry,	4
English,	5
Chemistry,	3
Agriculture,	3
Physics,	2
General History,	2
Military Drill,	3
Rhetoricals.	

WINTER TERM.

Geometry,	4
English,	5
Physics,	2
Poultry Industry,	4
Mechanical Drawing,	2
Chemistry,	2
Wood-work,	3
Military Drill,	3
Rhetoricals.	

SPRING TERM.

Geometry,	4
English,	5
Agriculture,	3
Cryptogamic Botany,	3
Physiology,	5
Military Drill,	3

Rhetoricals.

Laboratory Work each term.

JUNIOR YEAR.

FALL TERM.

Physics,	4
Book-keeping,	2
Horticulture,	3
English,	4
Solid Geometry,	3
Agriculture,	3
Military Drill,	3

Rhetoricals.

WINTER TERM.

English,	4
Trigonometry,	3
Book-keeping,	2
Dairying,	4
Horticulture,	4
Mechanical Drawing,	2
Wood-work,	3
Dairy-Laboratory,	8
Hort.-Laboratory,	6
Military Drill,	3

Rhetoricals.

SPRING TERM.

Chemistry,	5
English,	4
Surveying,	2
Civics,	3
Agriculture,	3
Zoology,	3
Military Drill,	3

Rhetoricals.

Laboratory Work each term.

SENIOR YEAR.

FALL TERM.

Geology,	3
Meteorology,	3
Agriculture,	3
Veterinary Science,	5
English,	3
Elocution,	1½
Geology-Laboratory,	1½

Senior Addresses.

SUMMER TERM.

Entomology,	7
Agriculture,	3
Horticulture,	3
Botany,	3
Ornithology,	2

DOMESTIC SCIENCE.

FRESHMAN YEAR.

FALL TERM.

Physical Culture,	3

WINTER TERM.

Sewing,	1½
Physical Culture,	3

SPRING TERM.

Sewing,	1
Physical Culture,	3

SOPHOMORE YEAR.

FALL TERM.

Sewing,	4
Cooking,	2
Physical Culture,	3

WINTER TERM.

Sewing,	3
Lectures,	1
Cooking,	2
Physical Culture,	3

SPRING TERM.

Physical Culture,	3

JUNIOR YEAR.

FALL TERM.

Physical Culture,	3

WINTER TERM.

Physical Culture,	3

SPRING TERM.

Sewing,	4
Laundrying,	2
Lectures,	1
Physical Culture,	3

SENIOR YEAR.

FALL TERM.

Drafting,	6
Lectures,	1
Physical Culture,	3

WINTER TERM.

Sewing,	5
Lectures,	1
Physical Culture,	3

SPRING TERM.

Dress-making,	4
Lectures,	1
Physical Culture,	3

Course.	Term.	Senior Year. Elective Courses.				Optionals, for Laboratory Work.
General.	*Winter*	Mathematics, 5	English, 3	History, 3	Polit. Ec., 3	Mechanics, or Astronomy.
	Spring	Mathematics, 5	English, 3	History, 3	Electricity, 4	Chemistry, Mechanics, Botany, or Entomology.
Agriculture.	*Winter*	Mathematics, 5	English, 3	Agriculture, 3	Polit. Ec., 3	Chemistry, or Veterinary Science.
	Spring	Mathematics, 5 Bacteriology, 2	English, 3	Agriculture, 3 Dairying, 3	Electricity, 4 Geology, 4 Mineralogy, 4 Ornithology, 4	Chemistry, Agr., Vet. Sci., Botany, Dairying, or Entomology.
Horticulture.	*Winter*	Mathematics, 5	English, 3	Horticulture, 5	Polit. Ec., 3	Botany, or Chemistry.
	Spring	Mathematics, 5 Bacteriology, 3	English, 2	Horticulture, 3	Electricity, 4 Plant Diseases, 4	Botany, Chemistry, Entomology, or Hort.

Shop-work and Drill in each course. Mechanics in General Course, extra.
Bacteriology on Fridays in Agricultural and Horticultural Courses.

LIST OF TEXT-BOOKS.

"We owe all the great advances in knowledge to those who endeavor to find how much there is of anything." —*Maxwell.*

American Fruit Culturist, Thomas.
A Text-book of Physics, Wentworth and Hill.
Boston Cook Book, Lincoln.
Composition and Rhetoric, Waddy.
Civil Government, Martin.
Computation Tables, Crandall.
Dairy Bacteriology, Russell.
De Pontibus, Waddell.
Elements of Chemistry, Williams.
Elementary Botany, Kellerman.
Elements of Structural Botany, Campbell.
Elements of Ethics, Muirhead.
Elements of Morals, Janét.
English Grammar, Sheldon.
English Literature, Brooke.
Essentials of Algebra, Wells.
European History, Adams.
Feeds and Feeding, Henry.
Fertility of Soil, Roberts.
Field Surveying, Searles.
Foundations of Rhetoric, Hill.
From Chaucer to Arnold, George.
Gardening for Profit, Henderson.
Grammar School Arithmetic, Walsh.
History of Rome, Creighton.
Inorganic Chemistry, Avery.
Introduction to English Literature, Pancoast.
Introduction to American Literature, Matthews.
Laboratory Manual of Physics, Gage.
Landscape Gardening, Waugh.
Lessons in Vocal Expression, Curry.
Manual of Arms, Caliber .45 and .50.
Mediaeval Civilization, Adams.

Milk and its Products, Wing.
National Graded Course in Music.
North America, Carpenter.
Office Routine and Bookkeeping, Schwartz.
Organic Chemistry, Remsen.
Ornamental Gardening, Long.
Physical Mathematics, Bourgougnon.
Physiology and Hygiene, Martin.
Plane Geometry, Pettee.
Plane Surveying, Raymond.
Political Economy, Laughlin.
Practical Forestry, Fuller.
Practical Studies in Botany, Kellerman.
Profitable Poultry-Keeping, Beale-Weld.
Qualitative Chemistry, Lectures.
Quantitative Chemistry, Evans.
Realm of Nature, Mills.
Soils and Crops, Hunt and Morrow.
Solid Geometry, Wentworth.
Stock Breeding, Miles.
The Academy Song Book, Levermore.
Text-book of Geology, Dana-Rice.
Text-book on Roads and Pavements, Spalding.
The Soil, King.
The Transition Curve, Crandall.
Trigonometry, Wentworth.
U. S. History, Montgomery.
U. S. Army Infantry Drill Regulations.

COMMENCEMENT EXERCISES,

WEDNESDAY, JUNE 14, 1899.

10.00 o'clock A. M., at the College.

PROGRAMME

Part I.

1. MUSIC ; Orchestra, Overture, "Morning, Noon, and Night," . . . . . *Suppe*
2. PRAYER.
3. MUSIC : Orchestra, . "Polish Dance." *Scharwenka*
4. ARTHUR FRANKLIN GREEN, . "The Farm and the Mine"
5. SELMA ALIDA CARLSON, . . . "Dress"
6. FRANK DEXTER CLAPP, . . "Beautiful Grounds"
7. ROSCOE HOSKINS GARDNER, "Compulsory Student Labor"
8. IRVIN EDSON GILBERT, . . "The College and the Shop"
9. MUSIC : Glee Club, "A Cradle Song." *Harrington*
10. GEORGE MELVILLE GREENE, . "The College Library"
11. IDA LOUISE HOBBY, . . . "The Flowers"
12. WILLARD WHITAKER JAMES, ... "The Coming of the Electric Cars"
13. ELSIE SOPHIA LEACH, . . . "Good Music."
14. EDWARD FRANCIS MANCHESTER, "Our Representatives"

Part II.

15. MUSIC : Orchestra, "Overture to Zampa," . . *Herold*
16. WILLARD ERNEST MASON, . "The Nicaragua Canal"
17. GEORGE HARRY MINER, "Combating Bovine Tuberculosis"
18. WILLIS MILLS NETTLETON, . . "College Athletics"
19. MUSIC : MISS MARGARET McREYNOLDS, "My All," . . . . . *Carl Bohm*

20. BERTHA MAY PATTERSON, "The Study of Entomology"
21. CLARENCE DWIGHT SMITH, "Experiment Station Bulletins"
22. BENJAMIN HOVEY WALDEN, . "The Japanese Plum"
23. MUSIC: Glee Club, "Dried Apple Pie," . . *Beswick*
24. CASSIUS WAY, ... "Our Country"
25. ELMER CLINTON WELDEN, . . "Sowing Seed"
26. KATHERINE ROSETTA YALE, ... "The Tried and the Untried Receipt"
27. MUSIC: Orchestra, "Whistling Rufus," . . . *Mills*

Honor positions on the programme given for highest standing during the College Course. { 1st—KATHERINE R. YALE / 2d—ARTHUR F. GREEN

AFTERNOON EXERCISES.

2.30 o'clock.

MUSIC.

COMMENCEMENT ADDRESS.

"Put Yourself in His Place," Rev. Charles M. Lamson, D.D.

MUSIC, ... *Miss Margaret McReynolds*

"Creole Love Song."

CONFERRING DIPLOMAS.

AWARD OF THE RATCLIFFE HICKS PRIZES.

MUSIC.

CLASS MOTTO, *Esse Quam Videri.*

CLASS COLORS, Maroon and White.

ENTRANCE EXAMINATION.

1899.

ARITHMETIC.

Add 3-4 of 3 1-2 to 6-7 of 1 4-5.

Multiply .05279 by 76.25.

Divide .314 by 1.785.

A surveyor's chain has 100 links and is 66 ft. long. What decimal of a foot is the length of each link?

What is the cost of fencing a rectangular field 185 1-2 ft. long and 123 1-4 ft. wide, if the fence costs $0.50 a yard?

A bicycle geared at 72 goes as far in one complete turn of the pedals as a wheel whose diameter is 72 inches. How many feet will such a bicycle go at each turn of the pedals?

A hundred dollar share of bank stock sells for $155, and pays a dividend of 8 dollars per year. If the buyer pays $1.50 tax on the share, what per cent. net profit does he receive on his investment?

Find the interest of $125, from June 16, 1899, to March 25, 1900, at 6%, at 4%?

Find the square root of 86.9432.

Add: —

8	7	6	9
2	7	4	3
9	9	6	5
8	6	5	4
9	7	9	8
4	8	8	7
3	4	4	1
2	3	3	2
7	2	4	9
6	9	7	8
5	7	8	7
2	4	9	7
9	8	2	6
8	9	3	4
4	6	7	5
0	3	5	3
1	2	6	9
9	9	8	6

ENGLISH.

Spell, punctuate, and capitalize correctly what the examiner dictates.

Analyze, or diagram, the following sentences.

We never make a new word till we have made a new thought.

Life had long been astir in the village, and clamorous labor knocked with its hundred hands at the golden gates of the morning.

Education is learning the rules of the game of life.

In the above sentences, parse the words : — "astir", "its", "is".

Also, "learning", "rules", "clamorous".

Tell the difference in meaning between "rise" and "raise".

Write a sentence containing the verb "was" followed by a personal pronoun.

HISTORY.

Compare the Colonists of Massachusetts with those of Virginia?

What was the turning point of the Revolution, and why?

What territory has been gained by the United States since the Revolution?

What effect had the protective tariff upon the feeling between the North and South?

What effect did negro slavery have upon the white people of the South?

What is meant by state sovereignty?

What has caused business panics in the United States?

What was the cause of the war of 1812?

Give a half-page account of Benedict Arnold.

Give a half-page account of Robert E. Lee.

GEOGRAPHY.

Draw a map of Connecticut, and write on it the counties, indicating their positions.

Bound the town in which you live, and tell what you can about its products.

How would one go from your home to the Philippine Islands? Through what large cities would he pass? States? Countries?

What and where are the following, and for what are they noted? Paris, Yukon, Chesapeake, Nicaragua, Santiago, St. Petersburg, New Orleans?

Give the names of three seaports in South America; tell what country each one is in, and how each is situated?

ROSTER OF STUDENTS.

Post-Graduates.

Carlson, Selma Alida,	Vernon, Tolland Co.
Clapp, Frank Dexter,	East Windsor, Hartford Co.
Gardner, Roscoe Hoskins,	Rocky Hill, Hartford Co.
Gilbert, Irvin Edson,	Deep River, Middlesex Co.
Green, Arthur Franklin,	Mansfield, Tolland Co.
Hobby, Ida Louisa,	Mansfield, Tolland Co.
James, Willard Whitaker,	North Windham, Windham Co.
Leach, Elsie Sophia,	Plymouth, Litchfield Co.
Mason, Willard Ernest,	Mansfield, Tolland Co.
Manchester, Edward Francis,	Bristol, Hartford Co.
Miner, George Harry,	Vernon, Tolland Co.
Nettleton, Willis Mills,	Washington Depot, Litchfield Co.
*Patterson, Bertha May,	Storrs, Tolland Co.
Smith, Clarence Dwight,	Westminster, Windham Co.
Walden, Benjamin Hovey,	Scotland, Windham Co.
Way, Cassius,	Gilead, Tolland Co.
Welden, Elmer Clinton,	Scotland, Windham Co.
Yale, Katherine Rosetta,	Meriden, New Haven Co.

Senior Class.

1900.

Baldwin, Frederick Joseph,	Watertown, Litchfield Co.
Bishop, Edwin Stanley,	Clintonville, New Haven Co.
Brown, Marie Carrie,	Vernon Center, Tolland Co.
Edmond, Herman Deane,	Westminster, Windham Co.
Emmons, Harry David,	Plymouth, Litchfield Co.
Grant, Gertrude Eliza,	Mount Hope, Tolland Co.
Hall, Hester Clarice,	Willington, Tolland Co.
Jacobson, Anna Christina,	Gurleyville, Tolland Co.
Karr, Irving Charles,	West Haven, New Haven Co.
Latimer, Edith Sara,	West Simsbury, Hartford Co.
Latimer, Lena Eliza,	West Simsbury, Hartford Co.
Lyman, John Bowers,	East Hampton, Windham Co.

*Married Harry Lucien Garrigus, '98, Nov. 29, 1899.

Mason, Christie Jennie,	Mansfield, Tolland Co.
Mason, Eva Belle,	Mansfield, Tolland Co.
Nason, Edna Mabel,	Gurleyville, Tolland Co.
Osmun, Albert Vincent,	Danbury, Fairfield Co.
Squire, Hanna Bertha,	Storrs, Tolland Co.
Williams, Horace George,	East Hartford, Hartford Co.

Junior Class.

1901.

Barnes, Jessie Rebecca,	Collinsville, Hartford Co.
Blakeslee, Joseph Howard,	Plymouth, Litchfield Co.
Brown, Edwin Pike,	Vernon Center, Tolland Co.
Case, Clarence Norton,	Hartford, Hartford Co.
Cox, Harold Wiggins,	Woodstock, Windham Co.
Dimock, William Wallace,	Merrow, Tolland Co.
Downing, Theodore Francis,	North Windham, Windham Co.
Fairchild, Charles Wentworth,	Nichols, Fairfield Co.
Kuzirian, Elia Tom,	Storrs, Tolland Co.
Plumb, Frederick Henry,	Nichols, Fairfield Co.
Pratt, Frederick William,	Deep River, New London Co.
Thorpe, Walter Franklin,	North Haven, New Haven Co.
Vallett, John Hamilton,	Uncasville, New London Co.

Sophomore Class.

1902.

Bushnell, Howard Linden,	Danielson, Windham Co.
Carpenter, John Skinner,	East Hampton, Windham Co.
Clark, Alfred Byron,	Beacon Falls, New Haven Co.
Clark, Arthur Nathaniel,	Old Saybrook, New London Co.
Crowell, Stephen Mills,	Middletown, Middlesex Co.
Dewey, Levi Terry,	Wapping, Hartford Co.
Farrell, John Joseph,	Storrs, Tolland Co.
Freeman, Vera Estelle,	Spring Hill, Tolland Co.
Goodrich, Elizabeth Emily,	East Hampton, Windham Co.
Gorton, Alfred Carl,	New London, New London Co.
Harvey, Leslie Ford,	Minortown, Litchfield Co.
Hollister, George Herbert,	Washington, Litchfield Co.
Jackson, Frederick Augustus,	Storrs, Tolland Co.
Lamson, George Herbert, Jr.,	East Hampton, Windham Co.
Mason, Daisie May,	Mansfield, Tolland Co.
Olin, Jennie Maude,	Plainfield, Windham Co.
Twing, James Byron,	Wallingford, New Haven Co.
Watrous, Helen Eunice,	Cambridgeport, Mass., 183 Columbia St.
Wheeler, Laura Josephine,	Trumbull, Fairfield Co.

Freshman Class.

1903.

Conger, Anna Martha,	Storrs, Tolland Co.
Foubert, Charles Leon,	Danbury, Fairfield Co.
Garrigus, Annie Belle,	Wolcott, New Haven Co.
Garrigus, Minnie Belle,	Wolcott, New Haven Co.
Hale, Moseley,	South Glastonbury, Hartford Co.
Hauck, Arthur Charles,	Spring Hill, Tolland Co.
Herold, Gertrude Marie,	Terryville, Litchfield Co.
Johnson, David Chester,	Bridgeport, Fairfield Co.
Koons, Grace Elizabeth,	Storrs, Tolland Co.
McLean, Frank Samuel George,	South Glastonbury, Hartford Co.
Mitchell, Warren Elliott,	New Haven, New Haven Co.
Noack, Hugo Rudolph,	Stamford, Fairfield Co.
Pierpont, Morton Elbert,	Waterbury, New Haven Co.
Quintana, Antonio de,	Pinar del Rio, Cuba.
Shaffer, Harry Cecil,	Derby, New Haven Co.
Stocking, Wilbur Foshay,	Weatogue, Hartford Co.
Storrs, Ada May,	Spring Hill, Tolland Co.
Walters, George Edward,	Bridgeport, Fairfield Co.

Special Class.

Buell, Robert Ellis,	Gilead, Tolland Co.
Dresser, Bertha May,	Bristol, Hartford Co.
Flint, Georgiana Elizabeth,	Storrs, Tolland Co.
Hotchkiss, Luella,	Prospect, New Haven Co.
Hughes, Hilda Bertha,	Storrs, Tolland Co.
Lambert, Annie Moylan,	Unionville, Hartford Co.
Schaffrath, William,	Waterbury, New Haven Co.

Preparatory Class.

Akers, Ella Margaret,	Mansfield, Tolland Co.
Akers, David Lawrence,	Mansfield, Tolland Co.
Bosworth, Clarence Hawes,	Mansfield, Tolland Co.
Crandall, Louis Edgar,	Center Groton, New London Co.
Harding, Dora Imogene,	Lyme, New London Co.
Preston, Miles Bailey,	Hartford, Hartford Co.
Richardson, Clayton Everett,	West Willington, Tolland Co.
Richardson, Clarence William,	West Willington, Tolland Co.
Shurtleff, Dwight Knowlton,	West Ashford, Tolland Co.
Smith, Lionel Gerardo,	Cardenas, Cuba.
Snow, Walter Garfield,	Mansfield Depot, Tolland Co.
Southwick, Clara Marie,	Mansfield, Tolland Co.
Storrs, Gilbert Holland,	Spring Hill, Tolland Co.
Woodward, Sherman Prindle,	Bethany, New Haven Co.

Short Dairy Course.

1899.

Briard, Frank,	Thorndale, Pa.
Cook, Henry,	Waterbury, Conn.
Fitts, John N.,	East Windsor Hill, Conn.
Garrigus, Harry L.,	Waterbury, Conn.
Kimberly, Karmi,	West Goshen, Conn.
Palmer, Charles L.,	Storrs, Conn.

1900.

Bidwell, Albert F.,	Canton Center, Conn.
Canfield, Samuel M.,	South Britain, Conn.
Cass, Henry E.,	Waterbury, Conn.
Griffiths, John E.,	Moosup Valley, R. I.
Hitchcock, Lewis B.,	Waterbury, Conn.
Kohles, Herman,	Fitchburg, Mass.
Marion, Frederick L.,	North Woburn, Mass.
Southwick, Walter A.,	Mansfield, Conn.
Whitehead, Joseph F.,	Washington Depot, Conn.
Wikoff, D. W.,	Meriden, Conn.

Poultry Course.

1900.

Parker, Lucien,	South Coventry, Conn.

Summary.

Post-Graduates,	18
Senior Class,	18
Junior Class,	13
Sophomore Class,	19
Freshman Class,	18
Special Class,	7
Preparatory Class,	14
Dairy Students,	16
Poultry Students,	1
Total,	124

CLASS OFFICERS.

1900.	H. D. Emmons,	President.
1901.	E. T. Kuzirian,	President.
1902.	A. B. Clark,	President.
1903.	F. S. G. McLean,	President.

COLLEGE ORGANIZATIONS.

Eclectic Literary Society.

This Society holds weekly meetings for the purpose of improvement in writing and speaking. Original papers, declamations, and *ex tempore* debates are the principal features of its regular programs.

OFFICERS.

H. D. Emmons,	President.
H. D. Edmond,	Vice-President.
F. H. Plumb,	Secretary.
I. C. Karr,	Corresponding Secretary.
F. W. Pratt,	Treasurer.
S. H. Crowell,	Marshal.

Alethia Society.

This Society is composed of young women, for literary improvement, and offers a weekly program of readings, essays, criticisms, and social functions.

OFFICERS.

Anna C. Jacobson,	President.
Gertrude E. Grant,	Vice-President.
Georgiana E. Flint,	Secretary.
Helen E. Watrous,	Marshal.
Marie C. Brown,	First Director.
Jennie M. Olin,	Second Director.
Jessie R. Barnes,	Third Director.

College Shakespearean Club.

This club, like the above, has for its object the mental culture of its members. Weekly programs of declamations, essays, and debates afford an ample field for the exercise of literary ability and oratorical genius.

OFFICERS.

H. D. Williams,	President.
J. H. Blakeslee,	Vice-President.
T. F. Downing,	Corresponding Secretary.
W. W. Dimock,	Secretary.
R. S. Buell,	Treasurer.
F. J. Baldwin,	First Director.
E. P. Brown,	Second Director.
A. B. Clark,	Third Director.

C. A. C.

Natural History Society.

This scientific society was organized February 25, 1898, and is composed of faculty and students, for the furtherance of study in Natural History. The members usually meet bi-monthly.

OFFICERS.

F. J. Baldwin,	President.
Edith S. Latimer,	Vice-President.
A. V. Osmun,	Chairman of Committee.

Young Men's Christian Association.

The Young Men's Christian Association is organized by the students for the promotion of Christian fellowship among its members, and for the purpose of raising a higher standard of manhood among all students.

OFFICERS.

F. J. Baldwin,	President.
H. D. Edmond,	Vice-President.
J. H. Blakeslee,	Corresponding Secretary.
Prof. C. S. Phelps,	Recording Secretary.
H. G. Williams,	Treasurer.

Young Women's Christian Association.

"Earth's noblest thing, a woman perfected." — *Lowell.*

OFFICERS.

Edith S. Latimer,	President.
Marie C. Brown,	Vice-President.
Gertrude E. Grant,	Secretary.
Lena E. Latimer,	Treasurer.

COLLEGE PAPER.

C. A. C. Lookout.

(Published Monthly.)

H. D. Emmons, '00,	Editor-in-Chief.
A. V. Osmun, '00,	Business Manager.
T. F. Downing, '01,	Assistant Manager.
Mr. H. A. Ballou,	Treasurer.
J. H. Blakeslee, '01,	College Notes.
H. D. Edmond, '00,	Athletics.
F. J. Baldwin, '00,	Alumni Notes.
L. F. Harvey, '02,	Exchanges.

STUDENTS' ORGANIZATION.

H. D. Emmons,	President.
E. S. Bishop,	First Vice-President.
J. H. Blakeslee,	Second Vice-President.
A. B. Clark,	Secretary.
T. F. Downing,	Treasurer.

Students' Council.

E. S. Bishop,	President,
R. E. Buell,	Vice-President.
A. B. Clark,	Secretary.
J. H. Vallett,	Marshal.

C. A. C. ATHLETIC ASSOCIATION.

H. D. Edmond,	President.
T. F. Downing,	Vice-President.
L. T. Harvey,	Secretary and Treasurer.
W. W. Dimock,	Keeper.

Football Team, '99.

J. H. Blakeslee,	Captain.
T. F. Downing,	Manager.
H. D. Emmons,	Center.
H. D. Edmond,	Right Guard.
L. T. Harvey,	Left Guard.
H. G. Williams,	Right Tackle.
J. B. Twing,	Left Tackle.
J. H. Blakeslee,	Right End.

F. S. G. McLean, }
T. F. Downing, } . . . Left End.
A. V. Osmun, ... Quarter-Back.
E. S. Bishop, ... Right Half.
J. B. Lyman, ... Left Half.
A. N. Clark, ... Full-Back.
E. P. Brown, W. W. Dimock, M. Hale, Substitutes.

Baseball Team, '99.

W. M. Nettleton, ... Captain.
H. D. Emmons, ... Manager.
F. S. G. McLean, ... Pitcher.
J. B. Lyman, ... Catcher.
I. C. Karr, ... First Base.
W. M. Nettleton, ... Second Base.
J. H. Blakeslee, ... Third Base.
T. F. Downing, ... Short Stop.
A. N. Clark, ... Right Field.
F. W. Pratt, ... Center Field.
E. S. Bishop, ... Center Field.
G. H. Miner, ... Left Field.
L. F. Harvey, W. W. Dimock, Substitutes.

Polo Team, '99

J. B. Lyman, ... Captain.
C. D. Smith, ... Manager.
I. C. Karr, ... Goal.
E. S. Holley, ... Half-Back.
J. H. Blakeslee, ... Center.
J. B. Lyman, ... First Rush.
F. S. G. McLean, ... Second Rush.
T. F. Downing, C. Way, . . Substitutes.

MILITARY ORGANIZATION.

Company A.

Henry A. Ballou, Instructor in Military Science and Tactics, Captain and Commandant.

E. S. Bishop, . . . Cadet First Lieutenant.
F. J. Baldwin, . . . Cadet Second Lieutenant.

H. D. Edmond,	Cadet First Sergeant
J. C. Karr,	Cadet Q.-M. Sergeant.
A. V. Osmun,	Cadet Sergeants.
H. D. Emmons,	
J. B. Lyman,	
H. G. Williams,	
W. W. Dimock,	Cadet Corporals.
F. H. Plumb,	
C. W. Fairchild,	
E. P. Brown,	

ALUMNI ASSOCIATION.

Arthur J. Pierpont, '95,	President.
Charles R. Green, '95,	Secretary.
M. Hibbard Parker, '93,	Treasurer.

One Vice-President is elected from each class upon graduation.

ALUMNI.

1883.

Fred Birge Brown,	Lumber Dealer,	Mobile, Ala.
Charles Spencer Foster,	Buffer,	Terryville, Conn.
Henry Richard Hoisington, Jr.,	Farmer,	Coventry, Conn.
Burke Hough,	Chair Mfr.,	Gardner, Mass.
Arthur Sherwood Hubbard,	Emp'd in Mfy.,	Glastonbury, Conn.
Andrew Keith Thompson,	Express Agent,	New Haven, Conn.

1884.

Clifford S. Barnes,	Farmer,	Burlington, Conn.
Jerry Lincoln Fenn,	Lawyer,	Hartford, Conn.
Frank S. Hubbard,	Emp'd in Mfy.,	Winsted, Conn.
Andrew Hyde,	Vet. Surgeon,	Norwich, Conn.
Fred C. Leavens,	Farmer,	Wauregan, Conn.
Samuel Q. Porter,	Farmer,	Panora, Iowa.

1885.

Robert A. Ayer,	Lumberman,	Olympia, Wash.
Horace S. Eaton,	Farmer,	Fairfax, Vt.
Frank E. Fenner,	Merchant,	Waterbury, Conn.
Archer C. Ford,	Orchardist,	Grand Pass, Oregon.
Royal E. Myers,	Medicine,	Baltimore, Md.
Isaac B. Wakeman,	R. E. D. & Bkr.,	149 Broadway, N. Y.

1886.

John H. Atkins,	Farmer,	Middletown, Conn.
Eugene A. Bailey.*		
Edgar S. Blair,		Address not known.
Wilbur L. Chamberlain,	Farmer,	West Brookfield, Mass.
Fred T. Coe,	Bookkeeper,	93 Camp St., Meriden, Conn.
John H. Gardner, Jr.,	Vet. Surgeon,	Norwich, Conn.
Henry R. Hayden, Jr.,	Architect,	Northampton, Mass.

* Died Sept. 18, 1895, at Loveland, Col.

Selden W. Hayes,	As't Prin. F. Sch.,	Hartford, Conn.
Bruce Hough,	Chair Mfr.,	West Gardner, Mass.
Edgar J. Leavenworth,	Farmer,	Ansonia, Conn.
John B. Perry,	Farmer,	Clark's Falls, Conn.
Arthur L. Reed,	Forem. on Farm,	Mansfield Depot, Conn.
Fred A. Robinson,	Dentist,	Shanghai, China.
Ira B. Smith,	Salesman,	Pensacola, Fla.

1887.

Dexter E. Hall,	Salesman,	Box 1382, Merid'n, Conn.
William J. Irwin,	Emp'd in Mfy.,	15 Oak St., Hartford, Conn.
William S. Lee,	Farmer,	Hanover, Conn.
Sidney H. Perry,	Salesman,	Danielson, Conn.
Edward F. Weed,	Supt. of R. E.,	Rowayton, Conn.
John W. Yeomans,	Emp'd in Mfy.,	Hopedale, Mass.

1888.

Willette Lincoln Alley,	Butcher,	Banksville, Conn.
Wesley Roswell Coe,	Instr. at Yale,	2 Hillhouse Ave., New Haven, Conn.
Henry Bacon Hubbard,	Bookkeeper,	21 Orman Place, Brooklyn, N. Y.
George Henry Knowles,	Gardener,	Ellington, Conn.
Keeney B. Loomis,	Farmer,	So. Manchester, Conn.
Harry Lincoln Quinlin.*		
Charles William Roberts,	Farmer,	Middletown, Conn.
Clarence Henry Savage,	Farmer,	Storrs, Conn.
Charles Augustus Wheeler,	Instructor,	Storrs, Conn.

1889.

Merton Chapman,	Nurse,	Groton, Conn.
Samuel Hart Deming,	Cream Gatherer,	Box 24, Farmington, Conn.
Fred Alfred McKenzie,	Emp'd in Mfy.,	Atlantic Screen Co., Hartford, Conn.

1890.

Ernst Hamilton Brandt,	Mgr. Rub. Wks.,	18 South St., Mt. Vernon, N. Y.
Merrill Everett Brown,	Shipping Clerk,	68 Huntington St., New London, Conn.

* Died Feb. 24, 1893, at Newfield, Conn.

Charles James Gilmore,		Address not known.
Wilbur Lionel Goodenough,	Salesman,	Winchester Center, Conn.
Latham Hull,	Stock Breeder,	No. Stonington, Conn.
John Hunter Lacke,	Lawyer,	177 Montague St., Brooklyn, N. Y
Carlton Elbert Lane,	Grain Dealer,	481 E. Main St., Meriden, Conn.
Clarence Bronson Lane,	Asst. in Ex. Sta.,	New Brunswick, N. J.
George Neth,	Electrician,	59 Seymour St., Hartford, Conn.
Charles Backus Pomeroy, Jr.,	Farmer,	Willimantic, Conn.
Robert Garland Shepard,		Address not known.
Adolph Carl Sternberg,	Fruit Grower,	West Hartford, Conn.
Willis LeRoy Wetmore,	Farm Supt.,	Winchester, Conn.

1891.

Herbert Porch Caldwell,	Salesman,	234 Putnam St., Hartford, Conn.
Charles Vibert Chandler,	Grocery Clerk,	South Windsor, Conn.
Walter Ernest Cummings,	Farmer,	Spring Hill, Conn.
James Sumner Fowler,	Fruit Grower,	Florida.
John Carter Frisbie,	Farmer,	Southington, Conn.
Alfred Herbert Griswold,	Mechanic,	New Britain, Conn.
Arthur Gilbert Hall,	Salesman,	104 So. Colony St., Meriden, Conn.
Harry Grant Manchester,	Farmer,	Sta. A, Winsted, Conn.
George Henry Merwin,	Farmer,	Greenfield Hill, Conn.
Fred Rosebrooks,	Farmer,	Willimantic, Conn.
Walter Lyman Rosebrooks,		So. Coventry, Conn.
Charles Herbert Vibert,	Farmer,	Meriden, Conn.
Allen Rice Yale,	Farmer,	Meriden, Conn.

1892.

Charles George Allen,	Bookkeeper,	Turnerville, Conn.
Seth Herbert Buell,		Oberlin, Ohio.
Aaron William Fenn,	Farmer,	Plymouth, Conn.
Henry Edward French,	Salesman,	Hartford, Conn., care Dodge & Brewer.
George Henry Hall,	Salesman,	Manchester, Conn.
Walter Holden,	Salesman,	6 Franklin St., Norwich, Conn.
Walter Francis Schultz,		103 Woodland St., Hartford, Conn.
Herbert Edmund Warner,	Asst. & Stu. in San.,	Battle Creek, Mich.

1893.

Earnest Treat Beard,	Farmer,	Milford, Conn.
Walter Harley Bishop,	Farmer,	North Haven, Conn.
Charles Henry Brimble,	Y. M. C. A.,	150 Allyn Street, Hartford, Conn.
Frederick William Darnstedt,	Electrician,	Broad Street, Hartford, Conn.
William Bailey Dayton,	Farmer,	Plantsville, Conn.
Walter Morgan Dunivan,	Clerk,	21 Cooper Street, Brooklyn, N. Y.
Charles Wells Eddy,	Civil Engineer,	Simsbury, Conn.
Edward Blodgett Fitts,	Farmer,	N. Lebanon Center, N.Y.
William James Frey,	Bookkeeper,	Box 306, Hartford, Conn.
Martin Moore Frisbie,	Farmer,	Southington, Conn.
Harvey Clark Harrison,	Farmer,	Northford, Conn.
Martin Hibbard Parker,	Farmer,	So. Coventry, Conn.
Frank Curtis Osborne,	Merchant,	Pier 14, East River, New York City.
Homer Gurley Sperry,	Farmer,	Bolton, Conn.
Walter Arnold Warren,	Asst. in Hort. Dept.,	Storrs, Conn.

1894.

Charles H. Brimble,*		150 Allyn St., Hartford, Conn.
Hobart James Brockett,	Farmer,	Montowese, Conn.
Seth Herbert Buell,*		Oberlin, Ohio.
John Carter Frisbie,*	Farmer,	Southington, Conn.
Harvey Clark Harrison,*	Farmer,	Northford, Conn.
Martin Hibbard Parker,*	Farmer,	So. Coventry, Conn.
Louise Jane Rosebrooks,	Housekeeper,	Storrs, Conn.
Walter Francis Schults,*		Madison, Wis.
Anna Mabel Fitts, neé Snow,		E. Windsor Hill, Conn.
Herbert Edmund Warner,*	Student and Asst. in Sanitarium,	Battle Creek, Mich.
Walter Arnold Warren,*	Asst. in Hort. Dept.,	Storrs, Conn.
Nellie Louise Bingham, neé Wilson,		Mansfield, Conn.

1895.

Francis Ariel Bartlett,	Farmer,	Simsbury, Conn.
Martin Moore Frisbie,*	Farmer,	Southington, Conn.
Charles Robert Green,	Mailing Clerk,	161 Seymour Street, Hartford, Conn.
George Ransom Hall,	Employed in Mfg.,	Hartford, Conn. Care Veeder Mfg. Co.

* Post Graduates.

Arthur Joseph Pierpont,	Farmer,	Waterbury, Conn.
Arthur Edward Shedd,	Farmer,	Preston, Conn.
William Alonzo Stocking,	Instructor,	Storrs, Conn.
Arthur Hatch Sturdevant,	Farmer,	Bridgewater, Conn.
Albert Buckingham Tyler,	Farmer,	Bristol, Conn.

1896.

Howard Grant Barber,	Teacher,	Union, Conn.
Grace Emily Eddy,* neé Blakeman,	Housekeeper,	Simsbury, Conn.
Olive Nicholson Clark,	Housekeeper,	Old Saybrook, Conn.
Albert Ernest Coles,	Housekeeper,	Rockfall, Conn.
Clayton Theron Curtis,	Farmer,	E. Glastonbury, Conn.
John Harry Evans,	Clerk,	Thompson, Conn.
Ethel Eugenia Freeman,	Clerk,	Chaplin, Conn.
Olcott Frederick King,	Clerk,	South Windsor, Conn.
Grace Edith Snow,	Teacher,	Jewett City, Conn.
Leroy Minor Tucker,	Farmer,	Middletown, Conn.
Ernest Henry Waite,	Clerk,	Middletown, Conn.

1897.

Harry E. Atwood,	Farmer,	Kensington, Conn.
Robert D. Beardsley,	Clerk,	Plymouth, Conn.
Frederick N. Buell,	Soldier 3d Regt.,	Conn. Vols.
Fred F. Bushnell,	Student,	Ithaca, N. Y.
Francis Comber,	Clerk,	Elmwood, Conn.
John N. Fitts,	Fireman,	Storrs, Conn.
Charles L. Foskett,	Farmer,	Winsted, Conn.
Erma L. Fuller,	Teacher,	Mansfield, Conn.
Albert C. Gilbert,	Asst. in Chem. Lab.,	Storrs, Conn.
Arthur O. Green.†		
Grove H. Johnson,	Lecturer,	WinchesterCenter,Conn.
Victor E. Luchinni,	Clerk,	Boston, Mass.
Harry B. Luce,	Farmer,	New Britain, Conn.
Benjamin S. Taylor,	Farmer,	So. Glastonbury, Conn.
Dennis Julian Burgess,	Student,	Willimantic, Conn.
Charles Sydney Chapman,	Foreman,	Shelton, Conn.
Charles Stoddard Francis,	Farmer,	Newington, Conn.
Harry Lucian Garrigus,	Farm Supt.,	Woodbine, N. J.
Walter Stanley Gillette,		North Haven, Conn.

* Married Nov. 9, 1899.

† Died April, 1898, at Hartford, Conn.

Willis Nicholas, Hawley.*		
Herbert Kirkpatrick,	Asst. Exp. Sta.,	Storrs, Conn.
Edwin Shepard Mansfield,		North Haven, Conn.
Herman Frederick Onthrup,	Teacher,	Middletown, Conn.
Joseph William Pincus,	Instructor,	Woodbine, N. J.
Max Schaffrath,	Bookkeeper and Typewriter,	Exp. Sta., Storrs, Conn.
Clinton Gold Smith,	Supt. of Grounds,	Spelman Seminary, Augusta, Ga.
George Ernest Smith,	Surveyor,	Derby, Conn.
Norman James Webb,	Machinist,	Plymouth, Conn.

Graduates, upon changing their address, are requested to communicate with the President of the College, that the above list may be kept up to date, and the aid of class secretaries and all others is solicited, that the list may be properly revised each year.

SUMMARY.

Whole number of students graduated up to 1900, one hundred and sixty-six, of whom twelve are women.

Farmers,	65	Salesmen,	8
Manufacturers,	8	Clerks,	10
In Trade,	4	Dentist,	1
Buffer,	1	Signal Service,	1
Express Agent,	1	Electricians,	2
Lawyers,	2	Civil Engineer,	1
Vet. Surgeons,	3	Lecturer,	1
Medicine,	1	Liveryman,	1
R. E. Dealer and Broker,	1	Soldiers,	2
Bookkeepers,	5	Nurse,	1
Architect,	1	Students,	4
Teachers,	12	Housekeepers,	5
Mechanic,	1		

* Died at Philadelphia, November 19, 1898. First Sergeant, Company H, Third Regiment, Connecticut Volunteers.

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CONNECTICUT COLLEGE



CONNECTICUT COLLEGE – REAR VIEW



REAR VIEW WITH LAKE--1898



GROVE COTTAGE



GROVE COTTAGE ENTRANCE HALL



GROVE COTTAGE—PARLOR



CHEMICAL LABORATORY



INTERIOR OF CHEMICAL LABORATORY



DRAWING CLASS



GREENHOUSE



INTERIOR OF GREENHOUSE



COTTAGE No. 2, ERECTED 1898.



COLLEGE CADETS



FOOTBALL TEAM



FARM HOUSE AND BARN



CONNECTICUT COLLEGE HERD — 1898

STATE OF CONNECTICUT
PUBLIC DOCUMENTS.

ANNUAL REPORT

OF THE

SHELL-FISH COMMISSIONERS



For the Year ending September 30,

1899.

BRIDGEPORT, CONN.:
STANDARD ASSOCIATION PRINTERS AND PUBLISHERS.

Officers and Employees of Shell-Fish Commission.

SHELL-FISH COMMISSIONERS.

GEORGE C. WALDO, Bridgeport,
CHRISTIAN SWARTZ, South Norwalk,
SETH SANFORD, Redding.

CLERK.

A. McC. MATHEWSON, New Haven.

ENGINEER.

DAVID C. SANFORD, New Haven.

INSPECTOR NATURAL OYSTER BEDS.

WILLIAM A. LEWIS, Bridgeport.

OYSTER POLICE.

DAVID RISLEY,	New Haven,	District No.	1
ALBERT W. BALDWIN,	Milford,	" "	2
J. E. JOHNSON,	Bridgeport,	" "	3
FRANK BROWN,	Bridgeport,	" "	4
ANDREW S. MILLS,	Rowayton,	" "	5
ALBERT F. PALMER,	Sound Beach,	" "	6

INSPECTORS OF MUD-DUMPING.

THOMAS E. BENEDICT, for New Haven.
EDWARD KNIGHT, for New Haven.
FRED. F. BROWN, for Bridgeport.
FRED. A. LEWIS, for Westport.
CHARLES E. GODFREY, for Five Mile R. and Norwalk.
OSCAR S. YOUNG, for Wilson's Cove and Cos Cob.
FRANK L. COOKE, Stamford.
HENRY PETERS, for Greenwich.

Office of the Commission, Exchange Building, Corner Church and Chapel Streets, New Haven; Rooms 301-303.

Days of Meeting, Every Tuesday at 2 o'clock P. M.

REPORT.

To the Hon. George E. Lounsbury, Governor:

In conformity with the Statutes of 1895, requiring an annual report from all Boards and Commissions of the State, the Shell-Fish Commissioners have prepared and herewith respectfully submit their report for the year ending September 30th, 1899.

THE COMMISSION.

The members of the Commission are George C. Waldo, of Bridgeport, Christian Swartz, of South Norwalk, and Seth Sanford, of Redding.

Mr. A. McC. Mathewson continues Clerk of Shell-Fisheries, and the Office of the Commission is in the Exchange Building, on Chapel street, New Haven, rooms 301-303.

Mr. D. C. Sanford is employed as engineer.

NEW LAWS.

At the legislative session of 1899 but two enactments were passed affecting the oyster industry. One is an amendment of section 2318 of the general statutes, concerning the notification of parties in interest of applications for oyster grounds, and the other is an act concerning Oyster grounds, prohibiting the drawing of dredges under water across said grounds, under penalty. These two enactments will be found in full in the appendix to this report.

Other legislation, desirable in the opinion of the Commissioners and of many of the oyster planters of the State, was proposed but failed. Further reference will be made to this hereafter.

THE FINANCIAL STATEMENT.

Reference to the financial statement will show the money received and expended by the Commission during the year ending Sept. 30, 1899.

The partial failure of the set in the years 1897 and 1898 and the consequent contraction of cultivated grounds during those years accounts undoubtedly for the small decrease in the amount of taxes collected, which is a little over three hundred dol-

lars, while the increase of more than eleven hundred dollars in the receipts for New Oyster Grounds during the year shows the improved conditions which have stimulated the acquiring of grounds within the present year, and which will doubtless be manifested in tax receipts hereafter. The total of receipts will be seen to exceed those of the year previous.

The item of outlay for the inspection of mud dumping which is put by itself aside from the other items in the account, will be seen to exceed that of the previons year by more than nine hundred dollars, and it is proper here to remark that this is an item of expense which might easily be saved the State, as this Commission has pointed out heretofore.

The law affecting the appointment and pay of inspectors, a wise and proper law and in the interest of the State, leaves the Commissioners no option, they must appoint, and upon the receipt of properly attested bills, pay the inspectors, and the money thus paid lessens by so much the receipts of the State from the oyster industry.

Having the interests of the State in mind, a bill was framed by the Clerk of the Commission and presented through the proper committee to the General Assembly last winter.

It put the payment for the inspection of mud dumping upon the contractors and relieved the State from that expense. The form of the proposed law was approved by the Attorney General, the purpose of it received a favorable report from the Committee which had it in hand, and it was thought that so simple and obvious a saving to the State, fair to all concerned and discriminated against no one, would be made a law. Diligent search fails to reveal it in the reported statutes of the session, and notwithstanding its excellent character and recommendations, it appears to have been lost somewhere in the Legislative shuffle wherein similar mysterious disappearances not infrequently occur. The Commissioners give notice herewith, however, that the bill will reappear at the next session and be once more put upon its travels.

The item of $1,876.42 for the buoying of Natural Oyster Beds of the State will be seen to exceed the amount expended the year previous very considerably although an examination of the tabulated statement of appropriations and expenses following the financial statement, will show that the appropriation was not exceeded. It was found two years ago that the limit of the law was

entirely inadequate to this work and an appeal to the State Board of Control secured the needed relief. This was followed by an increased appropriation more nearly adequate to the requirements of the work and since then the Commissioners have been enabled to do the work in a fairly satisfactory manner.

The other items of the expense account are essentially the same as in previous years and are all within the appropriations made.

THE BUOYING OF NATURAL BEDS.

The "good set" upon the natural beds this year has made the buoying of them a matter of more moment than usual and the Commissioners have done all that they have thought advisable and prudent in that direction, although not always able to meet the demands of the workers upon the natural beds or of adjacent proprietors. One very natural and unavoidable effect of the establishment of State buoys has been to lead adjacent planters to neglect the buoying of their lines wherever such lines lie upon those natural beds which the Commissioners are required by law to buoy. While this is entirely natural it is not the intent of the law to relieve the adjacent planter from the keeping up of his own lines and it is impossible for the Commission, unless it should have a steamer and material constantly on hand, to answer all the demands of proprietors and to keep exposed lines continually buoyed. The detail of the buoy work for the year will be found on another page.

INSPECTION OF MUD DUMPING.

This year the dredging work incident to the river and harbor improvement along this coast provided by the last Congress and involving the expenditure of upwards of $600,000 has been begun, and the increased expense for mud dumping, previously referred to, is thus accounted for. It has been shown that the State could save this expense easily and it has also indicated that another attempt to bring about that condition of affairs will be made. For the coming year a large proportion of the expense of mud dumping will be saved through an arrangement made by Mr. Henry C. Rowe of New Haven with the government contractors, by which he provides for the placing of the dredged material at New Haven and Bridgeport upon Oyster

grounds and for the payment of inspection by the contractors. In this connection the Commission can with considerable confidence repeat what they have said before with reference to this experimental side of the Oyster business. The progressive element in the business finds a large field for development in the improvement of grounds not originally valuable for Oyster culture, and although the results are not always fully up to the expectations or desires of all those engaged in the work, it is true that grounds have been and are being thus improved continually and have received an appreciable and gratifying increase in value therefrom. Grounds that are uncultivatable at any time may become cultivatable through natural or artificial changes but it is obviously for the interest of the State that such grounds should be held at a merely nominal valuation for taxation till the change, natural or artificial, has been made. To compel the abandonment of such grounds would be a loss to the State ultimately and a hardship to those progressive Oyster planters who are constantly expending many thousands of dollars in experimenting on such grounds and who annually bring more or less of them under cultivation.

THE OYSTER POLICE.

The item of $2,931.82 in the expense account of the financial exhibit for the year is the legal proportion of the tax receipts allowed for the purposes of policing the Oyster grounds of the State, and is expended under the excellent system devised by the Oyster Growers' Association. We believe that this system is satisfactory and hear no complaint of its failure from the planters who have to do immediately with the work. The officers are selected by the men whose interests are involved and naturally are chosen for their special fitness for the work.

The State inspection of natural beds is under the charge of Capt. William A. Lewis of Bridgeport, and although the increased work upon the natural beds has involved a large number of new workers, no cases of violation of the law have been allowed to go unrebuked and the general efficiency of the inspection is acknowledged. There has been a custom more or less prevalent in the past, for a man working under the Connecticut laws upon the natural Oyster beds of the State, to cross the Sound to Long Island, make a pretended transfer of his boat for a nominal sum to

a citizen of New York, and qualifying thus under the New York law, to work upon the natural beds of that State, till such time as he may see fit to return to the Connecticut natural beds. In such cases the Commissioners have decided that the pretended sale out of the State, forfeits the Connecticut license the same as if the sale were valid, and a new license will be necessary to work in these waters, after such a transaction.

An apparent infringement upon the natural beds of the State has been discovered at Southport, where parties hold title to grounds originally granted in two-acre lots by the town. This case has been submitted to the Attorney General and by him referred back to the Commission, for further investigation and a special report to the Governor, to be made thereafter. Details of the case, prepared by the Clerk of the Commission, Mr. A. McC. Mathewson, will be found in the Appendix.

OYSTER LAWS.

Two years ago and before any movement had been made for the revision of the General Statutes the laws relating to the Oyster industry of the State were revised carefully by A. McC. Mathewson, Clerk of the Commission. A need for such a revision had long been felt by the Commission, and the work was done with their approval. This revision was subsequently submitted to the Oyster Growers' Association and referred to a committee for consideration. At the annual meeting of the association at Bridgeport in October last, President Henry C. Rowe commended the revision in his report to the association and it was subsequently adopted by that body. It will be submitted to the Commission for the revision of the General Statutes, for use by them in their work should they find it available. This revision is given in the Appendix.

THE NATURAL BEDS.

Especial attention has been drawn to the Natural Oyster beds of the State by the fact that an unusually fine set of Oysters this season has made work upon them profitable and has helped to make up the average for the slack years of the recent past. The fact that large quantities of seed oysters were being taken and were finding a market at fairly paying prices, has led to very extravagant talk about the value of the natural beds, their pro-

ductiveness and what they return to the State for the money expended in buoying them. While the entire revenue from the boat licenses would not be enough to do the work of buoying as it should be done, the State derives a direct benefit from the beds in the fact that a large number of her citizens are enable to win therefrom substantial assistance in the earning of a livlihood and the general Oyster business is largely helped by the purchase of much of the stock by local planters for their own grounds. At the same time the natural beds are not "gold mines" as they are sometimes called, and an exceptional year like the present only makes a fair average, taken in connection with the lean years of the immediate past. Because the "natural grothers," as they are denominated, are making a fairly good business out of the present "set," the disposition is to measure their obligations to the State by this year's outcome alone and to demand that they shall pay largely for their privileges in taxes of some sort. The uncertainties of the business are not given their due weight and in the successes of the good years the failures of the more numerous bad years are lost sight of. From the most authentic sources of information including both the buyers' and the sellers' estimates, it is safe to say that 550,000 bushels of seed oysters have been taken thus far this year from the Stratford, Bridgeport and Fairfield Natural beds.

REPAIRS OF SIGNALS.

Owing to the several applications in the eastern part of the State the signals at Hammonassett Point and Kelsey Point, Clinton, had to be rebuilt

As the old iron signal at Kelsey's Point was all down except one leg, the Hammonasssett had been down for three years, large chestnut poles were used in place of the old style of signal. Both poles are 60 feet in length, and have been painted three coats of white.

In the Spring two more signals in the eastern part of the State will have to be rebuilt, as more applications have come in which will require these signals before any buoying can be done.

The iron signals built by the State in 1883 do not stand well as they rust very quickly although they are galvanized, Nothing stands so long and gives so much satisfaction as chestnut poles.

THE COMMITTEE ON STATE EXPENSES, ETC.

The Committee authorized at the session of the General Assembly of 1897 to inquire into the matter of State receipts and expenses, made a report on Feb. 1st, 1899, to the Legislature then in session and in their report "The Shell-Fish Commission" appears as follows:—

"This Commission has full charge of and jurisdiction over the Oyster grounds of the State, and in this capacity has to do with a large and important industry, the source of one of the most valuable food-products of the State. The business of the Commission is apparently well and intelligently conducted at a moderate expense, which has usually been more than paid by taxes and boat licenses collected and other receipts of the office. For the past two years, however, the expenses have exceeded the receipts."

(The reasons of this excess of expenditures has been set forth by this Commission in the increased cost of inspection of mud-dumping and of buoying the natural beds and the means of its considerable modification made known.)

The Investigating Committee then goes on to remark upon the large amount of uncultivated grounds, held and subjected to small taxation, and it suggests that if capable of cultivation even though uncultivated it should be valued and taxed at its capacity valuation and not at its present producing value. It suggests that grounds should he distinguished as cultivatable and uncultivatable, rather than as cultivated and uncultivated, a distinction which the Shell-Fish Commission has recommended on several occasions.

In closing its notice of the Shell-Fish Commission the Investigating Committee says:—

"At a meeting of the Oystermen's Protective Association, composed of owners of boats authorized to take and gather Oysters from the natural beds, held previous to the meeting of the General Assembly, 1897, it was voted to ask the Legislature to make the license fee ten dollars for each boat, regardless of size. Such a fee would provide sufficient funds to do all the work that may be necessary on the natural beds in the way of buoys, landmarks and inspection. From information we have received, we believe it to be for the interest of the State that this be done."

THE BUSINESS GENERALLY.

Views of the conditions of the Oyster industry vary somewhat, according to the point of view. One planter and dealer finds the

outlook gloomy in the light of his experience, while another equally experienced takes heart at the outlook and finds it encouraging. It is proper to say that a reasonable and businesslike view of the situation prevails. The season has been a good one for the planter as well as for the worker upon the natural beds, and the outlook is regarded as very favorable by those whose long experience and success have given weight to their opinions. Some very pessimistic views have been put forth, but they are not generally shared by the successful men in the business. The firm of Henry C. Rowe & Co. announce some of the most phenominal days in their experience and a general and strong demand for their high grade goods. J. Smith & Sons, in the same line, make similar reports, and Smith Brothers, William M. Merwin & Sons, H. J. Lewis Co., and other large dealers in their class, report a great demand and a big business. From Bridgeport and Norwalk there are like returns, and the total of exported Oysters from the latter city is especially large. The aggregate losses last year, from shells and other materials planted, upon which no set was secured, was put at a quarter of a million dollars, as "a moderate valuation," and it is to be hoped that the present activity in the business will continue long enough to make good that loss and leave a margin of profit to the planters against the less bountiful years which experience has taught them will, sooner or later, be sure to follow. At the same time, one who has had to do with the business for ten or fifteen years and takes in the scope of the whole interest, can see an increased knowledge and an increased certainty in meeting the chances and changes of the business which give the intelligent planter an advantage that he has never before enjoyed. His resources are greater, he knows where and how to turn to meet whatever emergency may arise, and he is no longer bounded by the narrow horizon of his earlier environment. He makes and commands conditions, quite as often as they make and command him, and on the whole his knowledge, his experience, his command of means to ends, serve him as master of the situation.

GEORGE C. WALDO,
CHRISTIAN SWARTZ,
SETH SANFORD,
Commissioners.

FINANCIAL STATEMENT.

1898–99.

RECEIPTS.

Taxes Collected,	$7,455	86
Deeds of New Oyster Ground,	1,133	90
Boat Licenses,	702	00
Recording Deeds,	28	00
	$9,319	76

ADVANCES TO SHELL–FISH COMMISSION.

Office Expenses,	$ 500	62
Engineer's Department,	250	00
Special Engineering,	250	00
Taxes,	333	56
Buoying Natural Oyster Beds,	1,876	42
Oyster Police,	2,931	82
Inspecting Natural Oyster Beds,	400	00
	$6,542	42

Mud-Dumping, $1,314 61.

MONTHLY EXPENDITURES OF THE SHELL-FISH COMMISSION FOR FISCAL YEAR ENDING OCT. 1, 1899.

	Office Expenses.	Engineering.	Special Engineering.	Taxes.	Buoying Natural Beds.	Oyster Police.	Mud Dumping.	Inspecting Natural Beds.	Total.
Appropriation.....	$500 00	$250 00	$250 00	$300 00	$1,600 00	$2,800 00	$ 500 00	$ 400 00	....
Bal from 1898....	62	3 60	....	33 56	896 66	272 79	95 60	....	....
Total for 1899....	$500 62	$253 60	$250 00	$333 56	$2,496 66	$3,072 79	$ 595 60	$ 400 00	....
October.....	$ 42 58	.....	.....	$ 42 06	$247 03	$302 90	$105 00	.....	$ 739 57
November.....	42 58	.....	.....	155 00	220 03	309 32	74 06	.....	800 99
Total.....	85 16	.....	.....	197 06	467 06	612 22	179 06	.....	1,540 56
December.....	42 58	.....	$125 00	35 30	33 51	92 16	255 00	$100 00	683 55
Total.....	127 74	.....	125 00	232 36	500 57	704 38	434 06	100 00	2,224 11
January.....	42 58	.....	125 00	10 15	16 35	244 81	63 35	.....	502 24
Total.....	170 32	.....	250 00	242 51	516 92	949 19	497 41	100 00	2,726 35
February.....	42 58	$120 00	.....	14 86	.....	109 32	20 20	.....	306 96
Total.....	212 90	120 00	250 00	257 37	516 92	1,058 51	517 61	100 00	3,033 31
March.....	42 58	75 00	.....	.....	40 00	75 00	11 80	100 00	344 38
Total.....	255 48	195 00	250 00	257 37	556 92	1,133 51	529 41	200 00	3,377 69
April.....	42 58	.....	.....	7 71	18 00	109 32	105 50	.....	283 11
Total.....	298 06	195 00	250 00	265 08	574 92	1,242 83	634 91	200 00	3,660 80
May.....	42 58	15 00	.....	47 61	.....	174 00	44 30	.....	323 49
Total.....	340 64	210 00	250 00	312 69	574 92	1,416 83	679 21	200 00	3,984 29
June.....	42 58	.....	.....	.....	65 40	262 32	214 90	100 00	685 20
Total.....	383 22	210 00	250 00	312 69	640 32	1,679 15	894 11	300 00	4,669 49
July.....	42 58	.....	.....	.....	309 92	135 00	45 00	.....	532 50
Total.....	425 80	210 00	250 00	312 69	950 24	1,814 15	939 11	300 00	5,201 99
August.....	42 58	.....	.....	20 87	392 89	615 67	47 50	.....	1,119 51
Total.....	468 38	210 00	250 00	333 56	1,343 13	2,429 82	986 61	300 00	6,321 50
September.....	32 24	40 00	.....	.....	533 29	502 00	328 00	100 00	1,535 53
Total.....	500 62	250 00	250 00	333 56	1,876 42	2,931 82	1,314 61	400 00	7,857 03

MONTHLY EXPENDITURES OF THE SHELL-FISH COMMISSION FOR OYSTER POLICE, YEAR ENDING OCTOBER 1ST, 1899.

Appropriation	$901 60	$338 80	$607 60	$207 20	$459 20	$285 60	....
Balance from 1898	....	53 80	40 95	18 24	114 20	45 60	....
Total for 1899	901 60	392 60	648 55	225 44	573 40	331 20	....
	District No. 1.	District No. 2.	District No. 3.	District No. 4.	District No. 5.	District No. 6.	Total.
October	75 15	63 75	.....	.....	114 00	50 00	$ 302 90
November	75 00	.....	200 00	34 32	.....	.....	309 32
Total	150 15	63 75	200 00	34 32	114 00	50 00	612 22
December	75 00	.....	.....	17 16	.....	.....	92 16
Total	225 15	63 75	200 00	51 48	114 00	50 00	704 38
January	75 00	.....	169 81	.....	.....	.....	244 81
Total	300 15	63 75	369 81	51 48	114 00	50 00	949 19
February	75 00	.....	.....	34 32	.....	.....	109 32
Total	375 15	63 75	369 81	85 80	114 00	50 00	1,058 51
March	75 00	.....	.....	.....	.....	.....	75 00
Total	450 15	63 75	369 81	85 80	114 00	50 00	1,133 51
April	75 00	.....	.....	34 32	.....	.....	109 32
Total	525 15	63 75	369 81	120 12	114 00	50 00	1,242 83
May	75 00	.....	.....	.....	90 00	.....	165 00
Total	600 15	63 75	369 81	120 12	204 00	50 00	1,407 83
June	75 00	.....	.....	34 32	93 00	60 00	262 32
Total	675 15	63 75	369 81	154 44	297 00	110 00	1,670 15
July	75 00	.....	.....	.....	.....	60 00	135 00
Total	750 15	63 75	369 81	154 44	297 00	170 00	1,805 15
August	75 00	.....	226 67	71 00	183 00	60 00	615 67
Total	825 15	63 75	596 48	225 44	480 00	230 00	2,420 82
September	75 00	244 00	.....	.....	93 00	90 00	502 00
Total	900 15	307 75	596 48	225 44	573 00	320 00	2,922 82

OYSTER SET, WHEN FIRST DISCOVERED.

Report of Temperature of Water During Spawning Season, Three Miles Southerly From the Southwest Ledge Light House off New Haven in Six Fathoms of Water, by Capt. George Edward Lancraft of Lancraft Brothers.

Year.	Time When First Saw Set.	Lowest Temperature of Water.	Highest Temperature of Water.
1899.	August 5th.	69°	76°

The largest set also the Highest Temperature in eleven years.

OYSTER SET, WHEN FIRST DISCOVERED.

Report of H. D. Pausch of Port Chester, N. Y.

Year.	Time When First Saw Set.	Wind.	Temperature of Water in 3 Fathoms.	Condition.
1899.	July 29th.	.....	68°	.....
1899.	July 30th.	.....	69°	Spawning.
1899.	July 31st.	.....	68°	.....
1899.	August 1st.	North.	69°	.....
1899.	August 2d.	North.	68½°	.....
1899.	August 3d.	N. E & S. W.	72°	Spawning.
1899.	August 4th.	N. E. & E.	74°	.....
1899.	August 5th.	.....	72½°	.....
1899.	August 6th.	.....	78°	.....

Oysters Got Through Spawning about September 18th.
Stars grew the first three weeks about $\frac{7}{16}$ of inch.
Stars commence Spawning about July 30th.
Stars Got Through Spawning about August 5th.

BUOYS SET ON NATURAL OYSTER BEDS.

June 8, 1899.

60 Buoys were set on the Bridgeport and Stratford Natural Beds.

June 9, 1899.

12 Buoys were set on the Fairfield Natural Beds.

June 9, 1899.

16 Buoys were set on the Roton Point and Fish Island Nat'l Beds.

June 10, 1899.

18 Buoys were set on the Bridgeport and Stratford Nat'l Beds.

June 27, 1899.

8 Buoys were set on the Roton Point and Fish Island Nat'l Beds.

July 6, 1899.

23 Buoys were set on the Fairfield Natural Beds.

September 1, 1899.

48 Buoys were set on the Bridgeport and Stratford Nat'l Beds.

September 4, 1899.

27 Buoys were set on the Bridgeport and Stratford Nat'l Beds.

September 5, 1899.

25 Buoys were set on the Bridgeport and Stratford Nat'l Beds.

September 5, 1899.

24 Buoys were set on the Fairfield Natural Beds.

September 6, 1899.

36 Buoys were set on the Roton Point and Fish Island Nat'l Beds.

Making a total of 277 Buoys set during the year.

Original Grants from the State

During 1899.

NAME.	LOCALITY.	ACRES.	NO. APP.
Frederick S. Beardsley...	Milford.....	264 5-10	908
Frederick S. Beardsley...	Milford.....	52 5-10	909
Charles W. Beardsley.....	Milford.....	419	910
Frederick S. Selleck.....	Darien	18 5-10	905
Percy L. Johnson.....	Milford.....	111	913
Andrew Radel.....	Darien.....	243 4 10	914
Lewis E. Raymond.....	Norwalk.....	25	917
		1,133 9-10	

Grounds Returned to the State

During 1899.

NAME.	Locality.	Acres.
William I. Stevens.....	Norwalk.....	30
William I. Stevens.....	Norwalk.....	10
William I. Stevens.....	Norwalk.....	19.8
William I. Stevens.....	Darien.....	38
William I. Stevens.....	New Haven.....	100
William I. Stevens.....	Stratford.....	103.3
William I. Stevens.....	Stratford.....	103.3
Benjamin F. Palmer.....	Greenwich.....	20

AMOUNT OF MATERIAL DREDGED TO IMPROVE HARBORS.

Dumped Under the Personal Supervision of State Inspector.

Locality.	Month.	Cubic Yds. of Material.	No. Scows.	Inspector.
New Haven	May	6,175.	22	Edward W. Knight
New Haven	June	8,420.	8	Thomas E Benedict
New Haven	July	18,967.	28	Thomas E. Benedict
New Haven	August	8,001.	67	Edward W. Knight
New Haven	September	5,667.	48	Edward W. Knight
Bridgeport	October	68,357.	102	Fred'k F. Brown
Bridgeport	November	10,451.	21	Fred'k F. Brown
Bridgeport	April	3,537.	28	Fred'k F. Brown
Bridgeport	May	13,507.	113	Fred'k F. Brown
Norwalk	August	12,435.	97	Charles E. Godfrey
Rowayton	June	12,981.	57	Charles E. Godfrey
Stamford	October	21,560.	95	Henry Peters
Stamford	November	16,085.	79	Henry Peters
Stamford	November	11,204.	81	Howard W. Taylor
Stamford	December	12,164.	59	Henry Peters
Stamford	January	983.	4	Henry Peters
Stamford	February	880.	4	Henry Peters
Stamford	July	5,172.	33	Frank L. Cooke
Stamford	August	6,505.	38	Frank L. Cooke
Stamford	September	7,970.	65	Frank L. Cooke
Sound Beach	February	779.	4	Henry Peters
Sound Beach	March	12,255.	64	Henry Peters
Sound Beach	April	12,069.	57	Henry Peters

AMOUNT OF MATERIAL PLANTED ON PRIVATE OYSTER GROUNDS.

CULTIVATORS.	LOCALITY.	No. Bushels Shells Planted.	No. Bushels Crush'd Stone Planted.	No. Bushels Long Island Gravel Planted.	No. Bushels of Gravel and Sand Dredged and Planted.	No. Bushels of Any Other.	Total Number of Bushels Planted.
American Oyster Co	New Haven	40,000	.....	.....	.....	.....	40,000
Ball, Ernest E	New Haven	15,000	.....	.....	.....	.....	15,000
Bell, Charles W	Rowayton	15,000	.....	.....	.....	.....	15,000
Brown, Isaac E	New Haven	40,000	.....	9,000	255,000	.....	304,000
Decker, David B	South Norwalk	45,000	900	.....	.....	45,000	90,900
Decker, Peter	South Norwalk	10,000	6,000	.....	.....	.....	16,000
Dewing, Martin	Providence, R. I.	16,000	.....	.....	.....	.....	16,000
Elsworth, J. & J. W	New York	2,000	.....	.....	.....	.....	2,000
Geib, A. A. & H. P	South Norwalk	5,000	.....	.....	.....	.....	5,000
Hamilton, A. E	New Haven	5,000	.....	.....	.....	.....	5,000
Hilton, Henry R	Rowayton	5,240	.....	.....	.....	.....	5,240
Hoyt, William H. & Son	South Norwalk	200,000	.....	.....	.....	.....	200,000
Hulse & Dunbar	New Haven	36,000	.....	.....	.....	.....	36,000
Lancraft Bros	New Haven	103,238	.....	.....	.....	.....	103,238
Lane, Frank T	New Haven	66,000	.....	.....	.....	22,000	88,000
Law, R. W. & Sons	New Haven	35,000	.....	.....	.....	5,000	40,000
Lawson & Martineau	South Norwalk	.....	.....	750	.....	.....	750
Lewis, H. J. Oyster Co	Bridgeport	118,171	123,437	.....	.....	.....	241,608
Lockwood, Elbert F	Cos Cob	45,000	.....	.....	.....	80,000	125,000
Ludington, C. L & Sons	New Haven	30,000	.....	50,000	.....	.....	80,000
Mansfield, F. & Sons	New Haven	55,000	.....	.....	.....	.....	55,000
Merwin, William M. & Sons	Milford	150,000	.....	.....	.....	.....	150,000
Nassau Oyster Co	Patchoque, L. I.	27,000	40,500	.....	.....	.....	67,500
Palmer, B. F	Sound Beach	.....	.....	45,000	.....	4,000	49,000
Palmer, H. F	Sound Beach	2,000	.....	.....	.....	.....	2,000
	Carried forward	1,093,649	170,837	104,750	255,000	156,000	1,752,236

AMOUNT OF MATERIAL PLANTED ON PRIVATE OYSTER BEDS—CONTINUED.

CULTIVATORS.	LOCALITY.	No. Bushels Shells Planted.	No. Bushels Crush'd Stone Planted	No. Bushels Long Island Gravel Planted.	No. Bushels of Gravel and Sand Dredged and Planted.	No. Bushels of Any Other.	Total Number of Bushels Planted.
	Brought forward	1,093,649	170,837	104,750	255,000	156,000	1,752,236
Parmelee. C. D.....	New Haven.....	70,000	.....	.....	.....	.....	70,000
Prior, E. M.....	Stamford.....	600	.....	.....	.....	.....	600
Radel, Andrew.....	Bridgeport.....	42,000	10,500	.....	.....	.....	52,500
Rowe, Henry C..	New Haven.....	246,000	.....	.....	300,000	.....	546,000
Rowland, Ocker & Westerbeke	New Haven.....	45,000	.....	.....	.....	.....	45,000
Royden, Wallace N.....	Milford.....	3,000	.....	.....	.....	.....	3,000
Smith, G. H.....	New Haven.....	100,000	.....	.....	.....	50,000	150,000
Smith, J. & Sons.....	New Haven.....	200,000	.....	.....	.....	.....	200,000
Smith Bros.....	New Haven.....	150,000	.....	.....	.....	.....	150,000
Smith Bros.....	Rowayton	.....	.....	.....	.....	25,000	25,000
Stevens, William I.....	Rowayton	25,000	27,000	.....	.....	.....	52,000
Stony Creek Oyster Co.....	Stony Creek....	23,000	.....	.....	.....	.....	23,000
Stratford Oyster Co.....	Stratford.....	30,000	.....	9,000	.....	.....	39,000
Thomas, John.....	New Haven.....	1,000	.....	.....	.....	.....	1,000
Von Glahn, Miss Anna W.....	New Haven.....	6,000	.....	.....	.....	.....	6,000
	Total.....	2,035,249	208,337	113,750	555,000	231,000	3,115,336

Amount of Star Fish Caught during the year.

CULTIVATORS.	LOCALITY.	No. of Bushels of Star Fish Caught.	No. of days Steamer worked to catch Stars.
Bells, Charles W.....	Rowayton	50	8
Brown, Isaac E.....	New Haven.....	400	22
Chard, Samuel.....	Greenwich.....	200	....
Cook, Oliver.....	Rowayton	10	....
Decker, David B.....	South Norwalk..	1,800	80
Dewing, Martin.....	Providence, R. I.	175	125
Elsworth, J. & J. W....	New York	250	40
Geib, A. A. & H. P.....	South Norwalk..	4	4
Hoyt, Wm. H. & Son....	South Norwalk..	2,000	35
Lancraft Bros.....	New Haven.....	500	30
Lane, Frank T.....	New Haven.....	500	40
Law, R. W. & Sons.....	New Haven.....	100	10
Lawson, & Martineau...	South Norwalk..	80	25
Lewis, H. J. Oyster Co..	Bridgeport	200	....
Lockwood, Elbert F....	Cos Cob.....	500	40
Luddington, C. L. & Sons	New Haven.....	50	25
Mansfield, F. & Sons....	New Haven.....	100	....
May Oyster Co.....	Bridgeport.....	500	15
Merwin, Wm. M. & Sons.	Milford.....	1,000	150
Nassau Oyster Co.....	Patchogue, L. I..	....	200
Palmer, B. F.....	Sound Beach....	50	....
Prior, E. M.....	Stamford.....	150	50
Radel, Andrew.....	Bridgeport.....	90	28
Rowe, Henry C..[erbeke	New Haven.....	1,200	270
Rowland, Ockers & West-	New Haven.....	....	80
Royden, Wallace N.....	Milford.....	50	10
Smith, George H.....	New Haven.....	100	30
Smith, Bros.....	New Haven.....	30	10
Stevens, Wm. I.....	Rowayton	850	56
Stony Creek Oyster Co..	Stony Creek....	25	15
Thomas, Thomas.....	New Haven.....	200	30
	Total.....	11,164	1,428

LIST OF OYSTER STEAMERS USED IN CONNECTICUT WATERS, 1898–9.

Name.	Tonnage.		Capacity.	Owner.	Locality.
	Gross.	Net.	Bushels.		
Falcon	46.18	23 09	700	J. & J. W. Elsworth Co	New York
Commadore	32.00	24.00	1,100	J. & J. W. Elsworth Co	New York
Commander	38.00	31.00	1,500	J. & J. W. Elsworth Co	New York
Lizzie S. Woodend	67.69	42 45	1,000	Van Name Bros	New York
J. P. Mesereau	.....	.....	1,500	Daniel Burbank	New York
Lizzie H	34.65	24.50	1,600	Jacob I. Housman	New York
F. C. & A. E. Rowland	55.78	26.82	1,000	D. K. Cole	Northport
Mystery	97.93	72.57	2,000	Cole & Thompson	New York
Harry	77.33	50.22	2,500	Peter Androvette	New York
Curiosity	.....	.....	1,000	Nassau Oyster Co	Patchogue
Daisy	6.21	5.61	300	Nassau Oyster Co	Patchogue
Precurser	99 66	34.83	1,000	Port Jefferson Oyster Co	Port Jefferson
Cambria	61 49	37 34	1,100	Breakwater Oyster Co	Greenport
A. M. Low	18.75	12.75	400	H. D. Pausch	Greenwich
H. S. Lockwood	69.50	34.75	1,000	E. F. Lockwood	Greenwich
Ithiel	31.93	15.97	800	Charles E. Palmer	Greenwich
Ripple	36 30	18.10	900	David B. Decker	So. Norwalk
J. Howard Lowndes	72.07	36 84	1,500	S. H. Lowndes	So. Norwalk
Waneta	19.89	9.95	500	Gould Hoyt	So. Norwalk
Cereus	16.57	8 29	400	Charles H. Vroom	So. Norwalk
Addie V	21.27	11.88	500	William Verity	So. Norwalk
Laurel	41.00	20.50	400	A. Solmons	So. Norwalk
Edith A	30.00	15.50	400	Joseph & Charles Vroom	So. Norwalk
Freddie W. Decker	20.00	14.36	800	Peter Decker	So. Norwalk
Mildred	123.37	66.57	3,000	Wm. H. Hoyt & Son	So. Norwalk
C. B. Lowndes	28.43	14.22	1,400	Mrs. Nellie Stevens	So. Norwalk

LIST OF OYSTER STEAMERS USED IN CONNECTICUT WATERS, 1898–9,

Name.	Tonnage.		Capacity.	Owner.	Locality.
	Gross.	Net.	Bushels.		
Henry J	42.42	26.96	1,200	F. S. Lowndes	So. Norwalk
Guess	14.00	10.15	600	W. B. Reed	So. Norwalk
Flora	20 49	10.25	500	A. D. Corson	So. Norwalk
Mabel Stevens	31.74	21.12	1,200	Wm. I. Stevens	So. Norwalk
Kate C. Stevens	104.65	52.33	2,500	Wm. I. Stevens	So. Norwalk
Medea	54.02	27.01	1,000	H. Rowlands	So. Norwalk
Molly	29.36	19.44	200	C. W. Bell	So. Norwalk
Alberta	23.78	13.28	500	B. Frank & Charles F. Howell	So. Norwalk
Adeline	20 07	7.33	300		Staten Island
D. K. Cole	31.87	15.94	300		Rowayton
Josephine	85.89	42 95	2,000	Andrew Radel	Bridgeport
Bond & Currier	94 86	66 63	1,400	Andrew Radel	Bridgeport
Ostrea	97.99	70 60	1,500	M. E. Morris	Bridgeport
Star Fish	18.08	9 04	300	M. E. Morris	Bridgeport
Jesse Clayton	56.23	28 17	1,200	M. E. Morris	Bridgeport
Stratford	91.02	45.51	2,000	Stratford Oyster Co	Bridgeport
Eureka	41 74	29.36	600	Henry J. Lewis	Bridgeport
Florence	84 86	64 60	1.200	Henry J. Lewis	Bridgeport
C. S. Conklin	52 96	34.15	950	Henry J. Lewis	Bridgeport
Virginia	83.10	46.50	1,000	Henry J. Lewis	Bridgeport
Dreadnaught	71.83	48.56	800	Pehr F. West	Bridgeport
Active	59.74	40.09	900	Pehr F. West	Bridgeport
Flash	6.00	4.00	300	Frank Hitchcock	Bridgeport
Etta May	99.55	49.78	1,300	May Oyster Co	Bridgeport
Loretto	19.06	9.93	800	W. M. Merwin & Son	Milford
W. M. Merwin	64.21	35.14	1,000	W. M. Merwin & Son	Milford

LIST OF OYSTER STEAMERS USED IN CONNECTICUT WATERS, 1898–9.

Name.	Tonnage.		Capacity.	Owner.	Locality.
	Gross.	Net.	Bushels.		
W. A. Cumming	76.17	40.84	1,100	W. M. Merwin & Son	Milford
Marion			300	Wallace N Royden	Milford
Jessie R		14.92	500	W. M. Rowland	New Haven
Spark	22.15	10.08	200	C. D. Parlmelee	New Haven
Pioneer	44.37	24.19	400	C. L. Ludington & Sons	New Haven
Luzerne Ludington	74.27	37.14	1,000	C. L. Ludington & Sons	New Haven
W. H. Lockwood	48.94	29.71	800	H. C. Rowe & Co	New Haven
Gordon Rowe	57.99	29.00	1,000	H. C. Rowe & Co	New Haven
Ruel Rowe	147.85	73.93	2,400	H. C. Rowe & Co	New Haven
Mikado	76.92	51.33	900	J. Smith & Sons	New Haven
Daisy E. Smith	61.68	30.84	1,200	J. Smith & Sons	New Haven
Jeremiah Smith	113 38	66.28	2,300	J. Smith & Sons	New Haven
Enterprise	34 00	20.65	800	Hulse & Dunbar & Lancraft Bros	New Haven
Isaac E Brown	85.68	56.17	1,400	Isaac E. Brown	New Haven
Ivernia	13.35	6 68	900	C. E. Thompson	New Haven
James Morgan	35.99	27.80	900	American Oyster Co	New Haven
Emily Mansfield	66.28	47.82	1,200	F. Mansfield & Sons	New Haven
Cleo	30.00	15.00	500	F. Mansfield & Sons	New Haven
J. & G. H. Smith	42 53	21 26	800	G. H. Smith	New Haven
J. & P. Thomas	79.02	48.48	1,500	Thomas Thomas	New Haven
Smith Brothers	64.74	48.74	1,600	Smith Bros	New Haven
Amanda	74.53	37.27	1,300	Lancraft Bros	New Haven
Richard W. Law	113.62	56.81	2,000	Richard W. Law	New Haven
Frank T. Lane	64 82	43.34	1,500	Frank T. Lane	New Haven
Pansy	10 80	10.00	400	Stony Creek Oyster Co	Stony Creek
Jennie	18 99	14.62	300	G. M. Long & Co	New London

LIST OF OYSTER STEAMERS USED IN CONNECTICUT WATERS, 1898–9.

Name.	Tonnage.		Capacity.	Owner.	Locality.
	Gross.	Net.	Bushels.		
Carrie V	.....	.....	200	Lancraft Bros	New York.
M. Dewing	71.47	51.47	1,000	M. Dewing	Providence.
Belleport	13.00	12 00	300	M. Dewing	Providence.
Rhoda E. Crane	15.36	10 56	500	Burdette Parks	Greenport.
Oysterman	14.00	13.00	500	Lewis Blue Point Oyster Cult. Co.	Sayville
Cyguet	7.00	4.50	300	E. S. & G. W. Dayton	New Haven.
Four Sisters	.....	.....	600	Frazer & Sofield	New York.

Alphabetical List of Owners of Oyster Grounds

WITHIN THE JURISDICTION OF THE STATE, WITH THE NUMBER OF ACRES OWNED BY EACH, AS SHOWN BY THE BOOKS OF THE SHELL-FISH COMMISSION ON NOVEMBER 1, 1899, THE DATE OE THE LAST COMPLETED TAX LIST.

Name.	Post Office Address.	Acres.
Alling, Henry M	New Haven	210.7
Ambler, W. F	South Norwalk	100.
American Oyster Co	New Haven	991.3
Anglo American Oyster Co	New Haven	315.1
Armstrong, C. H.	Bridgeport	52.9
Armstrong, D. N	Bridgeport	48 2
Atwood, Rufus K	Boston, Mass.	349.4
Atwood & Higgins	Boston, Mass.	200.
Backus, H. C	New Haven	200.
Ball, Ernest E	New Haven	350.
Banks, Mark, Estate of	Greenwich	2.
Beardsley, A. J. & Son	Bridgeport	39.2
Beardsley, F. J	Stratford	91 8
Beardsley, F. S	Stratford	311.
Beers, Alfred B	Bridgeport	185.8
Bell, Charles	Southington	100.
Bell, Charles W	South Norwalk	330.
Bell, Hiram, Est	South Norwalk	12.
Bell & White	Rowayton	120.
Benedict, Clifford E	New Haven	240.
Bogart & Miller	New Haven	299.
Bohner, John J	Brooklyn, N. Y.	40.
Bradley & Platt	West Haven	47.5
Brooks, F. D. & B. S	Danbury	50.6
Brown & Houche	Groton	19.5
Brown, Isaac E	New Haven	1,116.
Brown, James M	Guilford	21.7
Buffham, G. R	Baltimore, Maryland	30.
Bunnell, Charles W	New Haven	40.
Butler, Herbert M	Auburn, R. I.	65.2
Callahan, Eugene A	New Haven	10.5
Case, Elmer E	Rowayton	36.
Chard, Samuel	Greenwich	245.
Chard, Samuel L	Greenwich	36.4
	Carried forward	6,306.8

Name.	Post Office Address.	Acres.
	Brought forward...	6,306.8
Cole, H. W.	Rowayton	28.7
Collinge, John, Est.	Greenwich	14.
Cook, Oliver	Rowayton	205.
Corson, A. D.	Perth Amboy, N. J.	100.
Craw & L'Hommedieu	Rowayton	40.
Creegan, Thomas	New Haven	17.4
Crockett, Alfred S.	Rowayton	3.5
Crockett, Julia L.	Rowayton	12.1
Crofut & Waters	Darien	9.6
Cumming, Thomas	Sound Beach	30.7
Cumming, William A.	Stamford	295.
Cumming, W. A. & T.	Stamford	415.7
Davis, George N.	Port Chester, N. Y.	6.
Dayton, Bros. Co.	New Haven	101.8
Dayton, John.	Greenwich	2.
Dayton, John & Bro.	Greenwich	221.5
Decker, David B.	South Norwalk	78 7
Decker, John	Stamford	10.
Decker, Josephine J.	South Norwalk	44.4
Decker, Peter.	South Norwalk	316.
Decker, Sylvester P.	South Norwalk	96.
Decker, Lawson & Martineau	South Norwalk	35.
Decker & Raymond	South Norwalk	204.4
Delano, Thomas H.	Greenwich	24.
DeWaters, John H.	Rowayton	131.
DeWaters & Stevens	Rowayton	79.
Dewing, Martin,	Providence, R. I.	530.
Dibble, Alphonso.	Rowayton	120.
Dibble, Stephen E.	Rowayton	10.
Eaton, C. N.	New Haven	125.1
Elley, Mrs. Janet.	New Haven	89.
Ellsworth, J. & J. W. Co.	New York, N. Y.	639.6
Ferris, George W.	Sound Beach	10.
Forbes, C. B.	Guilford	23.
Ford, Adolphus L.	Sound Beach	25.
Ford, Claudia M.	Sound Beach	10.
Ford, Elbert L.	Milford	164.
Ford & Brown	Bridgeport	103.3
Ford & Ryle	Sound Beach	78.7
Fordham H. & Sons	Greenport, L. I.	118.
Fordham, Henry C.	Stratford	50.
Frazer & Stevens	Norwalk	36.
Geib, A. A. & H. P.	South Norwalk	199.
Goodsell & Miller	Bridgeport	241.8
	Carried forward....	11,400.8

Name.	Post Office Address.	Acres.
	Brought forward..	11,400.8
Guilford Oyster Co.	Boston, Mass	376.
Hart & Raymond	Rowayton	10 4
Hasson, E. J.	New Haven	13.5
Heath, Andrew	South Norwalk	10.
Hilton, Henry R.	Brooklyn, N. Y.	16.
Hollins & Ott	Rowayton	38.7
Holly, Newman	Port Chester, N. Y	11.5
Hopkins, Clinton I.	Greenwich	46.
Hopkins, Judson W	Greenwich	20.
Hopkins, Gilbert I.	Mianus	35.
Hotchkiss, Wm. T.	New York, N. Y.	83 2
Hoyt, Charles W	Bridgeport	15.
Hoyt, Gould	South Norwalk	82.9
Hoyt, Henrietta L.	South Norwalk	30.
Hoyt, J. S.	Rowayton	24.
Hoyt, W. F	South Norwalk	29.7
Hoyt, W. H. & Son	South Norwalk	1,237.
Howell, B. F. & C. F	South Norwalk	95 3
Huested, G. F. Est	Stamford	50.
Hull, Louis K.	Minneapolis, Minn.	105.8
Hulse & Dunbar	New Haven	116.
Hurd, Charles A	Bridgeport	86.6
Hynard & Marshall	Greenwich	5.
Johnson, Henry S.	New Haven	107.
Knapp, James F	Mianus	9.
Lancraft Bros	New Haven	1,078.9
Lane, Frank T.	New Haven	1,187.
Lane, Fred A	New Haven	30.
Lane, F. T. & F. A	New Haven	108.
Lane & Linsley	New Haven	60.
Law, J. H. & S. B.	New Haven	262.
Law, Richard W	New Haven	208.
Law, Richard W. Jr	New Haven	175.
Lewis, The H. J. Oyster Co.	Bridgeport	8,754.8
Liverman, W. W.	Noroton	21.6
Lockwood, E. F.	Cos Cob	1,144.1
Lockwood, Theron W.	Rowayton	13.6
Lowndes, Stanley H.	Northport, L. I.	500.6
Lowndes, Theo. S	South Norwalk	299.
Ludington, Palmer & Eaton	New Haven	50.
Ludington, C. L. & Sons	New Haven	441.
Mallory, Est. of Geo. W	New Haven	150.
Mallory & Ball	New Haven	366.6
	Carried forward....	28,904.6

NAME.	POST OFFICE ADDRESS.	ACRES.
	Brought forward...	28,904.6
Maltby, Est. of C. S.....	Greenwich	20.9
Mansfield, F. & Sons.....	New Haven.....	982.9
Marsh, Henry E.....	New Haven.....	57.
Marshall, Benj.....	Stamford.....	15.
Marshall, Enoch Y.....	Mianus.....	39.
Marshall, W. F. & E.....	Mianus.....	18.
Marshall, Wilmot & Starkins....	Greenwich.....	95 2
Martin, Geo. W. & Sons.....	Port Chester, N. Y...	91.
Martin, Henry.....	Port Chester, N. Y...	6 3
May Oyster Co.....	Bridgeport.....	1,334.6
McCrodden, Rowland & Redfern.	Canarsie, L. I.....	96.3
McGuinness, John.....	Stamford.....	48.4
McNeil, John.....	New Haven.....	171.
Mead, Est. of D. S.....	Greenwich	124.5
Mead, Samuel.....	Greenwich.....	3.1
Meeker, Elizabeth.....	South Norwalk.....	96.
Meeks, Mrs. Peter A.....	New Haven.....	50.
Merwin, S. O.....	New Haven.....	64.6
Merwin, Wm. W. & Sons.....	Milford.....	1,948.0
Mills, E. B. & Co.....	Southport	51.6
Mills, Frank L.....	East Norwalk.....	5 7
Morgan, Henry P.....	South Norwalk.....	5.
Morris, Louis S.....	Bridgeport	150.
Morris, Mrs. Margaret E.....	Bridgeport	109.
Morris, Marshall E.....	Bridgeport	1,214.2
Nash, Charles J.....	Bridgeport	24.
Nassau Oyster Co.....	Patchogue, L. I.....	187.5
Newman, Chas. H.....	Sound Beach.....	9.
Newman, H. W.....	Sound Beach.....	5.
Newman, Oscar.....	Greenwich	9.
Newton, Henry G.....	New Haven.....	54.7
Orange Oyster Co.....	New Haven.....	514.3
Page John.....	New Haven.....	101 2
Palmer, Benjamin F.....	Sound Beach.....	76.
Palmer, Charles E.....	Sound Beach.....	250.8
Palmer, Clarence E.....	Sound Beach.....	25.
Palmer, Clarence E. & Fred.....	Sound Beach.....	64.3
Palmer, Ed. L.....	Sound Beach.....	8.
Palmer, George A.....	Sound Beach.....	46.
Palmer, H. Ferris.....	Sound Beach.....	18.
Palmer, Mary L.....	Sound Beach.....	23.
Palmer, R. A.....	Meriden.....	130.
Parmelee, C. D.....	New Haven.....	732.9
Parmelee, Richard H.....	South Norwalk.....	16.
	Carried forward....	37,946.6

Name.	Post Office Address.	Acres.
	Brought forward...	37,946.6
Pausch, Albert	Hartford	88.9
Peet, Benj. F	Southport	40.5
Peters, Henry	Port Chester, N. Y.	8.
Plander, John H	Rowayton	2.
Prior, Edward M	Stamford	6.5
Radel, Andrew	Bridgeport	2,511.3
Raymond, Charles W	Darien	44.
Raymond, Lewis E	South Norwalk	25.
Raymond, Robert A	Darien	25.
Reynolds, W. S	Greenwich	7.9
Roberts, Nathan	South Norwalk	12.
Roberts, William O	South Norwalk	12.
Rowe, B. N. & E. C	New Haven	50.
Rowe, Henry C	New Haven	8,802.7
Rowland, Ockers & Westerbeke	New Haven	425.
Royden, Wallace N	Milford	30.
Sanford, Philip G	Saugatuck	387.5
Sarles, L. W	New York, N. Y.	24.
Schmelk, Henry W. Jr	Canarsie, L. I.	112.
Seeley, C. Barnum	Bridgeport	10.
Selleck, Frederick S	North Stamford	33.8
Sherwood, Arthur	Greens Farms	12.
Simmell, F. X	Sound Beach	11.
Smith, George H	New Haven	415.4
Smith, Jeremiah & Son	New Haven	3,305.3
Smith, Mrs. Julia A	New Haven	38.
Smith, M. P. & R. T	New Haven	200.
Smith, S. F	New Haven	100.
Smith, Bros	New Haven	771.
Smith Bros	Rowayton	20.
Solmans, Alden	South Norwalk	860.1
Starkins, Samuel	Greenwich	106.5
Stevens, Aaron G	Rowayton	81.
Stevens, A. G. & G. W	Rowayton	4.
Stevens, George W	Rowayton	17.5
Stevens, William I	Rowayton	1,342.4
Stoney Creek Oyster Co	Stony Creek	138.3
Stratford Oyster Co	Stratford	1,009.7
Taylor, Hiram B	Rowayton	50.7
Thomas, John	New Haven	6.
Thomas, Thomas	New Haven	257.
Thompson, Charles E	New Haven	150.
Thompson, John E	New Haven	100.
Townshend, Charles E	New Haven	207.3
	Carried forward....	59,807.9

NAME.	POST OFFICE ADDRESS.	ACRES.
	Brought forward...	59,807.9
Townsend, George H.....	New Haven.....	944.3
Townsend, Brown & Rowe.....	New Haven.....	98.
Turpin, Emma L.....	Bridgeport.....	294.7
Tuthill, Alvah B.....	South Norwalk.....	54.
Van Wyen, John.....	Stonington.....	200.
Von Glahan, Anna W.....	New Haven.....	34 3
Vroom, Joseph.....	South Norwalk.....	8.
Webb, Henry L.....	East Norwalk.....	1.
Wedmore, & Barnes.....	New Haven.....	50.
Wedmore, C. K.....	New Haven.....	200.
Wells & Mead.....	Rowayton.....	55.3
West, Pehr F.....	Bridgeport.....	222.6
Wheeler D. Fairchild.....	Bridgeport.....	46.7
Wheeler, Frank.....	Meriden.....	409.9
White, E. H.....	Rowayton.....	100.
White, Merrill.....	New Haven.....	135.9
Wicks, D. P. & E. A.....	Rowayton.....	13.
Wicks & Bassett.....	Rowayton.....	8.
Wicks, G. A. & Hester.....	Norwalk.....	8 5
Wiggins, Floyd E.....	New Haven.....	48.8
Williamson, George.....	Rowayton.....	6.
Wilmott, W. H. & J. N	Darien.....	28.9
	Total.....	62,775.8

LIST OF VESSELS LICENSED TO WORK UPON THE CONNECTICUT NATURAL OYSTER BEDS.

No.	Name of Vessel.	Name of Captain.	Hailing Place.	License Fee.
1	Amateur	Wm. A. Lewis	Bridgeport	$2 00
2	Hattie J	Charles Nash	Bridgeport	2 00
3	Ibis	Geo. H. Linscott	Bridgeport	2 00
4	Annie Wheeler	Clifford St. John	New Haven	2 00
5	A. L. Beard	John R. Winans	Bridgeport	2 00
6	Libbie M	Joseph Ehlert	Bridgeport	3 00
7	Recreation	H. N. Hastings	Bridgeport	2 50
8	Echo	George D. Clark	South Norwalk	2 50
9	Teal	Fred Sturdevant	Bridgeport	2 00
10	Irene	Frank L. Mills	South Norwalk	2 00
11	Broadbill	Charles L. Lewis	Bridgeport	2 00
12	Kate	Ernest Clark	Bridgeport	2 00
13	Thistle	W. W. Young	Rowayton	2 00
14	Bertie	Melville Young	Rowayton	2 00
15	Jessie Johnson	Henry C. Fordham	Stratford	3 50
16	Parole	Charles Clark	Bridgeport	2 00
17	Rescue	John Cihak	Bridgeport	2 00
19	Fussy	Wm. Redfern	South Norwalk	3 00
20	Harp	Robt M. Utz	Rowayton	6 00
21	Viola May	E. B. Ford	Bridgeport	5 50
22	Pigeon	Wallace E. Bond	Bridgeport	2 00
23	Azellia	Wm. H. Tobey	South Norwalk	2 00
24	Mary Lavinia	John McGuinness	Stamford	3 50
25	Shelldrake	Edward L. Palmer	Stratford	2 00
26	Tillie C	John Jarvis	Rowayton	2 00
27	Lottie	Martin W. Knowlton	Rowayton	2 00
28	Chrysanthemum	C. W. Hoyt	Bridgeport	3 00

LIST OF VESSELS LICENSED TO WORK UPON THE CONNECTICUT NATURAL OYSTER BEDS.—Continued.

No.	Name of Vessel.	Name of Cartain.	Hailing Place.	License Fee.
29	Rambler	C. N. Raymond	Rowayton	$ 2 00
30	Emma	George Barnes	South Norwalk	2 00
31	Edna	J. R. Jennings	South Norwalk	2 00
32	Elsie M	Fred. F. Lovejoy	South Norwalk	2 00
33	Lillian	Alfred S. Crockett	Rowayton	2 00
34	Lida May	George A. Wicks	Rowayton	3 00
35	Martha	Hans Gager	Rowayton	2 00
37	Arrow	Chas. H. Gehrmann	South Norwalk	2 00
38	Ella May	Robert Case	South Norwalk	4 00
39	James A. Hoyt	James W. Hoyt	South Norwalk	2 00
41	Protection	C. W. Hoyt	Bridgeport	3 50
42	Cora	Chas. W. Renson	South Norwalk	2 00
43	Princess	John Miller	South Norwalk	2 00
44	Katie May	Albert Ayers	South Norwalk	2 00
45	Gracie	John H. Plander	Rowayton	2 00
46	Ethlene	Frank Hollins	Rowayton	2 00
47	Ada Morton	George W. Ferris	Stamford	4 50
48	Sadie E	Samuel Huested	Stamford	3 00
49	Claudia M	A. Lincoln Ford	Greenwich	2 00
50	Lizzie	H. P. Newman	Stamford	2 00
53	Nancy Hanks	John Jarvis	Rowayton	2 00
54	Susie E	G. H. Ackerly	Rowayton	2 00
55	Annette	James A. Smith	South Norwalk	2 00
56	Henry R	H. E. Walker	Rowayton	2 50
57	Simon Banks	William Bond	Bridgeport	4 00
58	Emma L	Daniel Sprague	Bridgeport	4 00
59	"R. & H."	B. P. Reed	South Norwalk	2 00

No.	Name of Vessel.	Name of Captain.	Hailing Place.	License Fee.
60	Ida Florence	Willis Bell	South Norwalk	$ 3 00
61	Mary F.	Samuel J. Ayers	South Norwalk	2 00
63	Ada	William H. Tobey, Jr.	South Norwalk	2 00
64	Phebe M.	Abraham Decker	South Norwalk	2 00
65	Willie	George W. Kinsey	South Norwalk	2 00
67	Heba	Edwin T. Tobey	South Norwalk	2 00
68	Elsie A.	Charles D. Tobey	South Norwalk	2 00
69	A. H. Purdy	Aaron Martineau	South Norwalk	2 50
70	Flying Dutchman	Clifford Cutbill	Rowayton	2 00
71	Ada L.	Charles H. Smith	South Norwalk	2 00
72	Columbia	Albert Darm	Bridgeport	2 00
73	Ida May	George Talmadge	South Norwalk	3 50
74	Willis B.	Peter Boerum	Rowayton	2 00
75	Carrie O.	William Metzger	Bridgeport	3 00
76	Edyth	A. P. Beers	Stratford	2 00
77	Clarissa O.	A. C. Bradley	New Haven	2 00
78	G. N. Warren	G. N. Warren	South Norwalk	2 50
79	Mary Queen	Frank Grant	Rowayton	2 00
80	Hattie A. Wallace	John McNeil	New Haven	9 50
82	Violet	Clarence C. Noble	Bridgeport	2 00
83	Eva B.	William E. Lyle	South Norwalk	2 00
84	Annie	John Nordstrom	Stratford	2 00
88	Minnie A.	John W. Burrows	Greenwich	2 00
89	Jennie B.	Oakey Smith	South Norwalk	2 00
90	Empress	John Decker, Jr.	Stamford	2 50
91	Annie Gertrude	B. F. Palmer	Greenwich	6 00
92	Julian	W. L. Whaley	Greenwich	2 50

LIST OF VESSELS LICENSED TO WORK UPON THE CONNECTICUT NATURAL OYSTER BEDS.—Continued.

No.	Name of Vessel.	Name of Captain.	Hailing Place.	License Fee.
93	Jennie Florence	David Hawley	Greenwich	$ 3 00
95	Dora Dean	Franz X. Simmels	Greenwich	7 00
97	Carrie May	A. W. Halsey	Bridgeport	2 00
99	Mary Bell	M. K. Palmer	Greenwich	4 00
100	Teaser	James Maher	Bridgeport	2 00
101	Valiant	Jin Dederick	Bridgeport	2 00
102	Grayling	Frand B. Couch	Bridgeport	2 00
103	Ariel	Fred. M. Rowland	Bridgeport	2 50
104	Aaron	Denis Quill	Stratford	2 00
105	Neptune	Wallace N. Royden	Milford	2 00
106	Mary Amelia	C. W. Mills	Bridgeport	2 00
108	Harry & Fred	George F. Waters	South Norwalk	2 00
109	Alida	Theodore S. Mayhew	South Norwalk	2 00
110	Clarence	Richard K. Whitson	South Norwalk	2 00
112	George D. Allen	John Thomas	New Haven	7 00
113	Belle Breckenridge	Thomas Thomas	New Haven	6 00
114	Titanion	George Dickenson	Stratford	2 00
115	Leo	Daniel P. Wicks	Rowayton	2 00
116	Agnes	George Hoyt	Bridgeport	2 00
118	If	Henry W. Wells	Rowayton	2 00
119	Edwin Forrest	John H. Monsell	Rowayton	2 00
120	Fanny S.	Samuel Starkins	Greenwich	2 50
121	Curlew	William H. Rowland	South Norwalk	2 00
124	Mabelle	Henry L. Case	Rowayton	2 00
125	Caution	F. T. Lyon	South Norwalk	2 50
127	Alice	Charles Westcott	Greenwich	3 50
128	Wave	Enoch Y. Marshall	Greenwich	2 00

LIST OF VESSELS LICENSED TO WORK UPON THE CONNECTICUT NATURAL OYSTER BEDS.—Continued.

No.	Name of Vessel.	Name of Captain.	Hailing Place.	License Fee.
129	Minnie VanName	Edson S. Sharp	Bridgeport	$ 7 50
130	Sneak	Andrew S. Mills	Rowayton	2 00
132	Tiger	Grant B. Rackett	Rowayton	2 00
133	Bessie	Edward N. Overton	Milford	2 00
134	Fearless	D. C. Lines	Milford	3 00
135	Dictator	George Culver	Stratford	2 00
136	Dictator	Edward M. Prior	Stamford	4 00
137	Etta C.	R. B. Wilmott	Greenwich	2 00
138	Maida	W. R. Merrill	Bridgeport	2 00
139	Whistler	C. A. Smith	Bridgeport	3 50
140	Wasp	George Eiseman	Bridgeport	2 00
141	Emma L. Tracy	William Wood	Bridgeport	2 50
142	Nellie	George Cleveland	Stratford	2 00
143	Florence T.	James Farewell	Greenwich	2 00
144	Thomas Armstrong	A. W. Baldwin	Milford	5 50
145	Pauline	W. Mills	Bridgeport	3 00
146	Julia	D. P. Morrell, Jr	South Norwalk	2 00
147	Patrol	E. F. Ford	Milford	6 00
148	Isabelle	William J. Smith	Stamford	2 00
149	Stanley Howard	Charles K. Wedmore	New Haven	8 00
150	Nellie J.	Charles Blackenburgh	South Norwalk	2 00
151	Sara L. Persall	Orin B. Byxbee	South Norwalk	5 50
152	Amy B. Cole	Hickson W. Cole	Rowayton	2 00
154	Hattie R.	William H. Reynolds	East Norwalk	2 00
155	May Flower	Charles Day	South Norwalk	2 00
156	Comet	Henry W. Baramore	Greenwich	2 00
158	Samuel C. Bond	P. F. West	Bridgeport	3 00

LIST OF VESSELS LICENSED TO WORK UPON THE CONNECTICUT NATURAL OYSTER BEDS.—Continued.

No.	Name of Vessel.	Name of Captain.	Hailing Place.	License Fee.
159	Agent	M. C. Prout	Branford	$ 8 00
160	Mildred	William R. Lowndes	South Norwalk	2 00
161	Henry H. Christie	Charles S. Jack	Stratford	7 50
162	Rival	George E. Adams	West Haven	2 00
163	Wanda	John S L'Hommedieu	Rowayton	2 00
164	Chew Chew	A. McFaggart	Stratford	2 00
166	Annie	Samuel J. Harrison	New Haven	2 00
168	Uneeda	David Nash	South Norwalk	2 00
169	Eva C	Andrew J Palmer	Greenwich	3 00
172	Alice Chase	William C. Edward	Bridgeport	2 00
173	Lulu	George A. Palmer	Greenwich	4 00
174	Mabel	Willis Keister	City Point	3 00
176	Mary D	Fred Degrott	Bridgeport	2 00
178	Florence	F. H. Turpin	Bridgeport	5 00
180	Jerome May	P. F. West	Bridgeport	5 50
181	Emma E	A. Eisenman	Bridgeport	2 00
182	Stormy Petrel	Christian Billings	Bridgeport	2 00
183	Jennie L	Theron Lockwood	Rowayton	2 00
186	Flight	Benjamin F. Stevens	Rowayton	2 00
187	Lady Emma	Charles H. Hoyt	Greenwich	2 00
189	Elsie	Stephen M. Newman	Mianus	2 50
190	Jennie R	Adolphus L. Ford	Stamford	4 00
191	Libbie M	James F. Hoyt	Bridgeport	5 50
192	Hardtimes	Joseph E. Hoyt	Stamford	2 00
193	Hazel L	Clarence Webb	East Norwalk	2 00
194	Dewey	Albert W. Eaton	New Haven	2 00
196	Anchor	David Miller	Bridgeport	2 00

No.	Name of Vessel.	Name of Captain.	Hailing Place.	License Fee.
197	Surprise	Edward Ayers	South Norwalk	$ 3 00
198	Ellen F.	Wesley Bradley	New Haven	2 00
199	Myrtle	Charles E. Stevens	Rowayton	2 00
200	Eva	Frank H. Richards	South Norwalk	2 00
201	Gene	Oliver Cook	Rowayton	2 00
202	Osprey	Joseph Belser	Morris Cove	2 00
203	Fanny	Henry Keister	New Haven	2 00
204	Jennie V.	H. L. Warm	South Norwalk	2 50
205	Ally Ray	Charles W. Ford	Sound Beach	2 50
206	Stranger	Douglass Marshall	New Haven	2 00
207	Pell	M. J. Decker	East Norwalk	11 00
208	Helene	H. E. Fowler	Bridgeport	2 00
209	Hattie	Walter Thompson	Rowayton	2 00
210	Savoy	Miles B. Beardsley	Bridgeport	5 50
211	Lucy Neal	Miles B. Beardsley	Bridgeport	2 00
212	Martin M. North	Oscar Newman	Greenwich	6 50
213	Irene	Addison Palmer	Sound Beach	5 00
214	Frou Frou	William Giblin	Stamford	2 00
215	Lola L.	George Evans	Bridgeport	5 50
216	Bradley	T. H. Clark	Bridgeport	2 00
217	Alida	G. W. Mattson	Stratford	2 00
218	Morsetta H.	P. M. Hart	Rowayton	2 00
219	Irene M.	George T. Fox	Black Rock	3 00
220	Nelly	J. W. Sherman	Westport	2 00
221	Louise	Charles Mills	Bridgeport	2 00
222	Pearl	Henry Sturdevant	Bridgeport	5 00
223	Crystal	Thomas E. Benedict	New Haven	7 00

LIST OF VESSELS LICENSED TO WORK UPON THE CONNECTICUT NATURAL OYSTER BEDS.—Continued.

No.	Name of Vessel.	Name of Captain.	Hailing Place.	License Fee.
224	Elmer L.	Howard A. Severance	Stamford	$2 00
225	Nelsie	Charles Cooper	Bridgeport	2 00
226	Mabel	Fred Clawson	Bridgeport	2 00
227	Star	John Ryle	Stamford	2 00
228	Skipper	Lewis Smith	Darien	2 00
229	Economy	John See	East Norwalk	2 00
230	Rachel	Harry Hunter	South Norwalk	2 50
231	Windward	H. N. Hastings	Bridgeport	2 00
232	Minnie B	Judson H. Williamson	Rowayton	2 00
234	Annie	Joseph Bedell	Bridgeport	2 00
235	Tormentor	L. F. Tyler	Branford	4 00
236	Lucy A. Lane	C. H. Webb	Stamford	7 50
237	Jennie	Charles Nichols	Bridgeport	2 00
238	Comfort	William G. McCann	Stratford	2 00
239	Bertie	J. W. Hopkins	Mianus	2 00
240	Ada	Gilbert J. Hopkins	Mianus	2 00
241	Alice	John F. Laraby	New Haven	2 00
242	Calista R	F. O. White	Rowayton	2 00
243	Calester	Charles Wescott	Greenwich	2 00
245	O K	Charles W. Brotherton	Norwalk	2 00
246	Elsie B	Elisha H. Tryon	Branford	2 00
247	Valentine Koon	W. N. Avery	New Haven	10 00
248	Sarah F. Tucker	Edward B. Palmer	Oyster Bay	6 50
249	Ruby	S. Herbert Minor	Greenport	2 50
250	Jessie R	E. H Thompson	Stratford	2 00
251	No Name	Elmer S. Tyler	Branford	2 00
252	Sharpie	Fred Hoyt	Bridgeport	2 00

LIST OF VESSELS LICENSED TO WORK UPON THE CONNECTICUT NATURAL OYSTER BEDS—Continued.

No.	Name of Vessel.	Name of Captain.	Hailing Place.	License Fee.
253	Kestrel	H. L. Couet	New Haven	4 50
254	Molly	Otto Vantalett	Bridgeport	2 00
255	Anneta	Robert Morris	Morris Cove	2 00
256	S. E. Smith	Isaac H. Baker	Stamford	3 00
257	Addie R	John H. De Waters	Norwalk	4 50
258	Effie M	John Page	New Haven	6 50
259	Sarah Lucinda	Samuel Chard	Greenwich	8 00
260	Annie V	Patrick J. Tate	Bridgeport	2 00
261	Florence May	Mansfield Toms	Stamford	2 00
262	Cora	S. L. Spencer	Clinton	2 00
263	Ariel	Wm. Smith	Stamford	2 00
264	Jewel	Charles H. Lyon	Hawthorne	2 00
265	Fred	O. L. Roberts	Guilford	6 00
266	Ivy Point	Isaac Payne	Rowayton	2 00
267	Mildred	Stanley Ferris	Sound Beach	2 00
268	Mary A	Frederick Jotry	Bridgeport	4 50
269	None Such	George H. Merwin	Milford	2 00
270	Juanita	George Helsinger	Bridgeport	2 00
271	Dorothy	L. W. Tryon	West Haven	2 00
273	Lorena B	George W. Byxbee	South Norwalk	3 50
274	Alar	A. Jelliffe	Bridgeport	2 00
275	Handy	Hans Lingdell	Stratford	2 00
276	Victor	Robert H. Denny	New Haven	2 50
277	Uno	Montgomery Morrill	Greenwich	2 00
278	Mary	Isaac C. Hull	Stratford	2 00
279	Echo	John F. Hammond	Stratford	2 00
280	Nellie C	Everett C. Hatter	Stamford	2 00

LIST OF VESSELS LICENSED TO WORK UPON THE CONNECTICUT NATURAL OYSTER BEDS—Continued.

No.	Name of Vessel.	Name of Captain.	Hailing Place.	License Fee.
281	Lucy	Chas. McKenzie	New Haven	$2 00
282	Nellie	George A. Clark	Stratford	2 00
283	Sword Fish	A. A. Geib	South Norwalk	2 50
285	Dewitt	Henry C. Smith	South Norwalk	2 00
286	Resolute	Wm. F. Mills	Saugatuck	2 00
288	Report	C. M. Bowen	Guilford	5 00
289	Marguerite	Edwin M. Silleck	Bridgeport	2 00
290	Alice G	A. Bloomquist	East Norwalk	2 50
291	Whale	Edward Sturdevant	Bridgeport	2 00
292	Polly	George T. Hine	Stratford	2 00
293	Hattie Lulu	James T. Byxbee	South Norwalk	2 50
294	Edith	Wm. L. Roberts	Guilford	2 00
295	Cleopatra	Henry T. Adams	West Haven	2 50
296	Laurel	Ralph S. Bradley	South Norwalk	2 00
297	Wild Duck	Wm. H. Raymond	Rowayton	2 00
298	Bertha	Edward Schroeder	South Norwalk	2 00
299	Mary F	Francis A. Boerum	South Norwalk	2 00
304	Wave	Frederick Oster	Stamford	2 00
306	Susie C	Stanley Chard	Greenwich	3 50
308	Emma Jane	Wm. B. Chard	Greenwich	5 50
310	Priscilla	C. F Hopkins	Mianus	5 00
314	Elsie	Fred. Marberg	Fairfield	2 00
318	Bertha A	Wm. H. Gehrmann	East Norwalk	2 00
319	Josie V	M. B. Soper	South Norwalk	2 00
320	Florence B	F. C. Hoyt	Bridgeport	2 50
322	Mary Underhill	Samuel Mott, Jr	Rowayton	2 50
326	Florence B	F. C. Hoyt	South Norwalk	2 50

LIST OF VESSELS LICENSED TO WORK UPON THE CONNECTICUT NATURAL OYSTER BEDS—Continued.

No.	Name of Vessel.	Name of Captain.	Hailing Place.	License Fee.
329	Wicked Sal	Dennis L. Dowd	New Haven	2 00
331	Sarah Beesley	M. L. Mills	Southport	2 00
335	Leslie	John H. Crockett	Rowayton	2 00
340	Sensation	Henry Myers	Hartford	3 00
348	Bessie	Peter J. Condon	Bridgeport	2 00
349	Kelpie	Robert B. Dibble	Rowayton	2 00

STATE OF CONNECTICUT
PUBLIC DOCUMENTS.

APPENDIX.

Oyster Laws Passed by the General Assembly.

Session of 1899.

The Case of the Southport Natural Beds.

Proposed Revision of Oyster Laws.

Laws Affecting The Oyster Industry, passed at the Session of the General Assembly for 1899.

CHAPTER CLII.

An Act Amending An Act Relating to Applications for Oyster Grounds.

Be It Enacted by the Senate and House of Representatives in General Assembly Convened:

Section 2318 of the General Statutes is hereby amended to read as follows:—

When any such application is filed with the Clerk of said Commissioners, he shall note on the same the date of its reception, and shall cause a written notice stating the name and residence of the applicant, the date of filing of the application, the location, area and description of the grounds applied for, to be posted in the office of the town clerk of the town bounded on the said Long Island Sound within the meridian boundary lines of which said grounds are located, and shall send a copy of said notice to each owner of oyster grounds bounded by said new application. Each application shall remain on file in the office of the Shell-Fish Commission for at least ten days after said notices have been so posted and mailed.

Any person or persons objecting to the granting of the grounds applied for, as aforesaid, may file a written notice to the Clerk, stating the grounds of his, or their objections, and in case the objections are so filed, the said Commissioners or a majority of them, shall, upon ten days' notice in writing, mailed or personally delivered to all the parties in interest, hear and pass upon such objections at such place as the Commissioners of Shell Fisheries, or a majority of them, may appoint, and if such objections are not sustained and the area of the ground is not, in the opinion of the Commissioners, of unreasonable extent, they may, for the sum of one dollar per acre, paid to the said Commissioners to be by them

paid over to the Treasurer of the State, grant a perpetual franchise for the planting and cultivating of Shell-Fish in such ground or in any part of the same in the manner aforesaid, and where no objections are made such grants may be made at any time after the expiration of said five days, for the consideration hereinbefore named.

At all hearings before them, said Commissioners may, by themselves or their Clerks, subpœna witnesses and administer oaths as in Courts of Law.

Approved June 1, 1899.

CHAPTER CLIV.

An Act Concerning Oyster Grounds.

Be It Enacted by the Senate and House of Representatives in General Assembly Convened:

Any person who shall, without the permission of the owner of any properly designated Oyster grounds, tow any Oyster dredge or contrivance for taking Oysters, under water upon such Oyster grounds, shall be fined not more than one hundred dollars, or imprisoned not more than sixty days, or both.

Approved June 1, 1899.

THE SOUTHPORT CASE.

In re controversey between
SHELL-FISH COMMISSION
and
TALMADGE & LYON,
Concerning Oyster Beds.

MEMORANDUM BRIEF.

In 1872 certain grants of Oyster grounds were made by the Committee of the Town of Fairfield, the grounds being situated at the mouth of the Southport Harbor, agreeable to the law then in force, relative to the granting of Oyster grounds. The grounds have been cared for by those to whom the original grants were made, and by their successors including the present owners, since the grants were made; and taxes have also been paid upon them, the present owners having paid the same for the past two years, and the tax soon to become payable being charged against them.

The Shell-Fish Commission does not deny the making of the grants; but makes the claim that the grounds were abandoned by the owners after a few years, and that the Commission, authorized in 1881 to locate the Natural Oyster Beds in the State jurisdiction, in making their report to the Legislature in 1885, included the grounds in dispute in the Natural Oyster grounds in the State jurisdiction.

These grounds have never been abandoned by their owners, and have never been released to the State. The stakes and buoys have occasionally gotten down, but have been replaced and restored within a reasonable time. These things happen to all Oyster grounds at times and cannot be prevented.

The whole question then turns upon the effect of those original grants, whether they are valid and binding, or otherwise; and the effect of the report of the Commission in 1885, describing the Natural Oyster Beds in the State jurisdiction, which was accepted, ratified, established and confirmed by the Legislature, upon those grounds.

The claim has *not been* made, and *is not* made, that these

grounds, at the *time of their designation*, were natural beds. It is admitted that the grants were made; and, as there is no claim made that at the *time of the grants* these beds were natural beds, the presumption is that they were *not* natural beds. Such being the case, the grants were valid when made and have continued so, despite the report of the Commission, made in 1885.

Section 2 of Chapter XCIV, Public Acts of 1877, provides:

> "All designation of places for planting or cultivating Oysters within the navigable water of any town, which have heretofore been made by authority of such town, through its Selectmen or Oyster Ground Committee, are hereby validated and confirmed,"

This was passed by the Legislature five years after the grounds in dispute had been designated by the duly authorized aud appointed Committee.

Again in 1878, Chapter XXIV, Sections 8, 9 and 10, of the Public Acts, provide:

> "Sec, 8. All applications and designations of ground in the waters of this State, for the purpose of planting or cultivating Oysters, heretofore made and granted, shall be good and valid, although such application may have been made for the purpose of transferring the right of planting or cultivating Oysters on the ground applied for, and all such transfers are hereby validated and confirmed.
>
> "Sec. 9. All applications and designations of ground in the waters of this State heretofore made for the purpose of planting Oysters thereon shall be also valid for the purpose of cultivating Oysters thereon.
>
> "Sec. 10. All designations of ground heretofore made for the purpose of planting or cultivating Oysters, and describing the ground as containing not over two acres, to each applicant, exclusive of muddy or rocky bottom, or other bad bottom, or containing other words indicating the exclusion of ground unfit for planting or cultivating Oysters, are hereby validated and confirmed, although the total quantity embraced in the designation may be more than two acres to each applicant; and such designations hereafter made shall be valid."

From the foregoing it is plainly apparent that the Legislature has at all times intended to protect those to whom grants have been made by Selectmen of towns or Committees, and to make good and valid any that were doubtfnl or uncertain.

It certainly seems, therefore, that up to this time there can be no doubt about the validity of the grants of these grounds. Moreover, it should be remembered that during all these years statutes were in force prohibiting, designating, staking, marking out, or enclosing for the cultivation of Oysters, etc., any *natural bed.* Therefore, the presumption again arises that at the time these beds were designated they were *not* natural beds.

Now, coming down to the appointment of the Commission by the Legislature, in 1881, (Public Acts,) Chapter CLX, we find the following:

> "Sec. 9. All designations and transfers of Oyster, Clam, or Mussel Grounds within the waters of Long Island Sound *heretofore made*, (*except* designations made of *natural* Oyster, Clam, or Mussel beds), are hereby validated and confirmed."

This is a part of the Public Act creating the State Commission for the Designation of Oyster Grounds and defining the powers of the Commission; and by this part *all* designations and transfers, except designations of *natural* beds, are validated and confirmed. Therfore, we claim that these designations, presumably *not* natural beds, are validated and confirmed by the Act which created the Commission in 1881.

The report of this Commission, made in 1885, Chapter CXVIII of the Public Acts, includes in the Fairfield Natural Beds, (page 531,) the grounds now in dispute; and the question now is, What effect has this report, and its acceptance by the Legislature, upon grounds *not* natural beds, properly designated by Committees and controlled by individuals, but included in the report as natural beds? Can the vested rights of these individuals be impaired, disturbed or destroyed by the retroactive enactment of the Legislature?

The case of Cook vs. Raymond, 66 Conn., 285, upon which the Commission largely relies, is not in point, or in any respect similar to the case in question except that it concerns Oyster grounds. In that case the grounds were, at the time of the des-

ignation by the Committee, *natural beds;* and of course, the grants were void. But it is not even claimed, in this matter, that the beds were natural at the time of their designation; the Commission depending upon this report of 1885, which includes these grounds as natural beds: in other words, depending upon retroactive legislation.

RETROACTIVE LEGISLATION.

In Shonk vs. Brown, 61 Penn., State Rep., 327, the Court says:

> "The true principle on which retrospective laws are supported was stated long ago by Duncan, J., in Mudernord vs. Lilly, 10 S. & R., 101, to wit: where they impair no contract or disturb no vested right, but only vary remedies, cure defects in proceedings otherwise fair, which do not vary existing obligations contrary to their situation when entered into and when prosecuted. The same principle is stated by strong, J., in the last case cited by the plaintiff in error, Journeay vs. Gibson, 6, P. F. Smith, 60; 'Such Legislative Acts,' he says, 'are sustainable only because they are supposed not to operate upon the deed or contract by changing it, but upon the mode or proof.'"

Generally it is held that a defective acknowledgment to a deed may be validated by a legislative act, if *vested rights* of third parties are not thereby impaired.

Green vs. Abraham, 43 Ark., 420.
Ferguson vs. Williams, 53 Iowa, 717.
Barton vs. Morris, 15 Ohio, 408.
Stevenson vs. Martin, 18 Penn., 101.
Skellinger vs. Smith, 1 Wash. Terr., 370.

In Am. & Eng. Encyclopædia of Law, (1st ed.,) page 757, Vol. 3, note 2, we find the following:

> "But whether or not retroactive laws are specially prohibited, the Legislature cannot pass any law divesting settled rights of property."
>
> Numerous cases cited.

And on page 758, of the same Vol. and work, is the following:

> "The Legislature has no power to pass a law impairing vested rights of property."

"Retroactive declaratory Statutes must not be allowed to affect vested rights."

Lamberton vs. Hogan, 2 Pa. St., 22.
Haley vs. Philadelphia, 68 Pa. St., 45.
McLeod vs. Burroughs, 9 Ga., 213.

A "vested right" is defined to be "a right fixed in a person" "an immediate right of present enjoyment."

Such being the case, can it be denied, or even disputed, that those to whom these grants were originally made, acquired vested rights thereby in these grounds? Can it be denied or disputed that at the time of the acceptance of the report of the Commisssion in 1885, these vested rights continued? Certainly not. Therefore, to give to this enactment of the Legislature of 1885, (Chapter CXVIII), the effect of voiding these grants will be to disturb and destroy these vested rights; and, in view of the authorities quoted, in all fairness, we think that this cannot be done.

PROPOSED REVISION OF LAWS.

Prepared by A. McC. Mathewson, Clerk of Shell-Fisheries.

Section 1. There shall be three Shell Fish Commissioners. The Governor shall, on or before May first, 1899, during the regular session of the General Assembly, and on or before May first of the regular session of said General Assembly quadrennially thereafter, nominate, and with the advice and consent of the Senate shall appoint two Shell Fish Commissioners, and shall, on or before May first, 1901, during the regular session of the General Assembly, and on or before May first of the regular session of said General Assembly quadrennially thereafter, nominate, and with the advice and consent of the Senate shall appoint, one Shell Fish Commissioner. The Commissioners so appointed shall hold their respective offices for four years from the first day of July next succeeding their respective appointments or until their successors are appointed and qualified; and any vacancy occurring in said Board for any cause may be filled by the Governor for the unexpired term.

Sec. 2. The Shell Fish Commissioners shall maintain an office in the city of New Haven; each of said Commissioners shall be paid not more than five hundred dollars for services and expenses under the provisions of this act in any one year. The office expenses shall not exceed the sum of five hundred dollars in any one year. Each of said Commissioners shall give a bond in the sum of two thousand dollars to the State with sufficient surety for the faithful performance of their duties and for the payment to the State Treasurer of all money that may come into their hands under the provisions of this act.

REFERENCES, ETC.

Section 1 is rewritten and is made to correspond in phraseology with other sections in the General Statutes relating to appointment of Boards. It combines Section 2310.

Sec. 1, Chap. CCXLVII, Pub. Acts, 1895.
Sec. 1, Chap. CC, Pub. Acts, 1889.
Sec. 1, Chap. CCXCI, Pub. Acts, 1895.

Section 2 combines the last sentence of Section 4 and Section 6, Chap. CC, Public Acts, 1889. This Section 6 is changed to conform to practice, also Chap. CCXLV, Public Acts, 1893. The provision for bonds is taken from Section 2316 and the balance of that Section is of no further use as the work is accomplished.

Sec. 3. The Shell Fish Commissioners shall appoint a Clerk, who shall be designated as Clerk of Shell Fisheries and shall hold office during the pleasure of said Commissioners. He shall receive as compensation for his services, fifteen hundred dollars, per annum in monthly installments. Whenever the Clerk shall be unable to act on account of sickness or absence he shall have power to appoint a clerk to act for him during his sickness or absence.

Sec. 4. The Shell Fish Commissioners may employ an Engineer for the work of the office and such field work as may be necessary in connection with said Commissioners. For all engineer's services in the office they shall pay five dollars per day and for all engineer's services and expenses a sum not exceeding five hundred dollars shall be expended in any one year. All expenses for engineering work for the determination of boundaries of oyster grounds of any person, or persons, shall be paid by the person or persons for whom the work is performed; in all grants of ground, the buyer of said grounds shall pay for all engineering expenses pertaining thereto, also for locating and delineating said grounds upon the map of oyster grounds on file in the office of said Commissioners the sum of three dollars for each of said grants.

REFERENCES, ETC.

Section 3 combines Chap. CCXLV, Pub. Acts, 1893, Section 2, Chap. CCXCI, Pub. Acts, 1895, and Section 6, Chap. CLXXI, Pub. Acts, 1893, with a change to agree with practice.

Section 4 combines Section 7, Chap. CC, Pub. Acts, 1889, Chap. CCXLV, Pub. Acts, 1893, and Pages 1017 Private Acts, 1897, and the last sentence is a note of the Commissioners in accordance with law.

Sec. 5. The State shall exercise exclusive jurisdiction and control over all shell-fisheries which are located in that area of

the State which is within that part of Long Island Sound and its tributaries bounded westerly and southerly by the State of New York, and easterly by the State of Rhode Island, and northerly by the following lines, to wit: commencing at Byram Point, the westernmost limit of the State at high-water mark, at a rock covered by the outermost clump of cedars; running thence in a straight line one and eight-tenths miles across the bays and inlets to a big white rock at the extremity of a point designated as Horse Neck Point on the U. S. Coast Survey map, and otherwise known as Field Point; thence from said white rock at Field Point, in a straight line in an easterly direction two and three-tenths miles across the waters of the bay and inlets, to a large boulder on a point designated on the U. S. Coast Survey map as Greenwich Point, otherwise known as Flat Neck Point; which boulder is situated southerly of the woods on said Flat Neck Point; thence from said last-named point, following the coast line at high-water mark seven-tenths of a mile to the extreme southeast point of said Greenwich Point; thence across the bays and inlets two and four-tenths miles to the most southern extremity of Shippan Point at high-water mark; thence along Shippan Point at high-water mark four-tenths of a mile to the southeastern extremity of said point; thence two and six-tenths miles to the southern extremity of Long Neck Point, at high-water mark; thence one and four-tenths miles to Colyer's Point, which is a point northerly of Fish Island; thence one and four-tenths miles to Roton Point, otherwise known as Bell Island Point; thence one-half mile to Southwest Point; thence following the outside high-water mark of Sheffield's or Smith's, Copp's, Goose, and Cockenoe's Islands six and five-tenths miles to Sherwood's Point; thence one and one-tenth miles to Farm's Point; thence two and five-tenths miles to Pine Creek Point; thence one and two-tenths mile to Shoal Point; thence three and five-tenths miles to the most southern point on the sea-wall of Seaside Park at Bridgeport, said point being about south from the center of Myrtle and Waldemere avenues; thence three miles to the southern extremity of Point no-point; thence one and seven-tenths mile along the shore at high-water mark to the southern extremity of Stratford Point, near the light-house; thence three and seven-tenths miles to the south side of Charles Islands; thence one and two-

tenths mile to Welch's Point; thence one and one-tenth mile to Pond Point; thence one and seven-tenths mile to Merwin's Point; thence one and one-tenth mile to Oyster River Point; thence five miles to South End; thence along the coast at high-water mark one and three-tenths mile to Johnson's Point, otherwise known as Darrows Island Point; thence seven and nine-tenths miles to the center of a large oval-shaped boulder lying on Hatch's Rock and about south of Mr. O. L. Robert's white barn at Sachem's Head; thence eight and four-tenths miles to Black Boy Point; thence along the shore at high-water mark three-tenths of a mile to Hammonassett Point; thence one and seven-tenths mile to Kelsey's Point; thence two and three-tenths miles to Menunketesuck Point; thence three and nine-tenths miles to a point in the town of Old Saybrook at high-water mark directly south of the beacon on Cornfield Point; thence due south in the line of the meridian one-third of a statute mile to a point; thence easterly in a straight line to the outer end of the east jetty of the Connecticut River; thence to Hatchett's Point; thence two and seven-tenths miles to Black Point; thence along the coast at high-water mark three-tenths of a mile to the southeast extremity of Black Point; thence two and four-tenths miles to Millstone Point; thence one and one-tenth mile to Magonk Point; thence along the coast at high-water mark one and seven-tenths miles to Goshen Point; thence two and eight-tenths miles to Avery's Point; thence one and seven-tenths mile to Bluff Point; thence one and one-tenth mile to Groton Long Point; thence along the coast at high-water mark three-tenths of a mile to the southeastern extremity of Groton Long Point; thence five and four-tenths miles to Stonington, or Windmill Point; and thence two and four-tenths miles to Pawcatuck Point, the eastern limit of the State. And all shell-fisheries not within said area shall be within the jurisdiction and control of the towns in which they are located. If a difference shall arise between any town and the Board of Commissioners of Shell-Fisheries as to the boundary line between said town and the said area, said town, by its selectmen, may bring its petition to the Superior Court for the county within which said town is situated, to determine said boundary line, and said court upon reasonable notice to the parties shall hear said petition and appoint a committee to ascertain the facts in such

case and report the same to said court, and said court shall thereupon make such order as may be proper in the premises.

Sec. 6. Said Commissioners shall also be empowered, in the name and in behalf of the State, to grant by written instruments, for the purpose of planting and cultivating shell-fish, perpetual franchises in such undesignated grounds within said area as are not and for ten years have not been natural clam or oyster beds, whenever application in writing is made to them through their clerk by any person or persons who have resided in the State not less than one year next preceding the date of said application, or by any joint stock company or corporation organized under the laws of this State, all the stockholders of which are citizens of this State. The said application and the said grant shall be in manner and form as shall be approved by the Chief Justice of the Supreme Court of Errors, and all such grants may be assigned to any person or persons who are or have been residents of the State for not less than one year next preceding such assignment, or to any joint stock company or corporation organized under the laws of this State, all the stockholders of which are citizens of this State, by a written assignment, in manner and form approved by said Chief Justice; and said Commissioners shall keep books of record and record all such grants and assignments therein.

REFERENCES, ETC.

Section 5 is copied from Chap. CXXIII, Pub. Acts, 1882, as in General Statutes, Sec. 2315.

Section 6 is copied from Sec. 2317 of General Statutes, except that the provisions of Sec. 2361 are incorporated into the seventh line, I doubt if it is necessary and would suggest that the words "married woman or minor" be striken out and in that way the whole of Sec. 2361 be dropped.

Sec. 7. When any such application is filed with the Clerk of said Commissioners, he shall note on the same the date of its reception and shall cause a notice stating the name and residence of the applicant, the date of filing the application, the location, area, and description of the grounds applied for, to be posted in the office of the town clerk of the town boundary on the said Long Island Sound within the meridian boundary lines of which said grounds are located, where such notice shall remain posted for twenty days. Any person or persons objecting to the grant-

ing of the grounds applied for, as aforesaid, may file a written notice with the Clerk, of said Shell Fisheries stating the ground of his or their objections, and at the end of said twenty days the said town clerk shall return said notice to the Clerk of Shell Fisheries; and in case said objections are so filed the said Commissioners or a majority of them, shall, upon ten days' notice in writing, mailed or personally delivered to all the parties in interest, hear and pass upon such objection at the town in which such grounds are located, as aforesaid, or such other place as the Shell Fish Commissioners, or a majority of them, may appoint, and if such objections are not sustained, and the area of ground is not, in the opinion of the Commissioners, of unreasonable extent, they may, for the sum of one dollar per acre, paid to the said Commissioners, to be by them paid over to the treasury of the State, grant a perpetual franchise for the planting and cultivating of shellfish in such ground or in any part of the same in the manner aforesaid, and where no objections are made such grants may be made for the considerations hereinbefore named. At all hearings before them, one of said Commissioners or their Clerk shall have power to sign and issue subpoenas and administer oaths as in court of law. The same shall be paid for recording or copying papers and maps in the office of the Shell Fish Commissioners as are charged by town clerks for like services; and all fees so paid shall be accounted for and paid to the Treasurer of the State for the benefit of the State.

REFERENCES, ETC.

Section 7 is Sec. 2318 corrected to conform to the law and practice and to make the proceedings certain. The last sentence is combined with the first part of Sec. 2331.

Sec. 8. All transfers of titles to oyster grounds within State jurisdication, which may hereafter be made, shall be recorded in the record books of the Shell Fish Commissioners; and it shall be the duty of the person, persons or corporation making such transfer to cause such record to be made forthwith; or in lieu thereof, to forthwith give written notice of such transfer to the said Commissioners, stating the date thereof, the name of the transferee or transferees, and the description of the grounds affected thereby; and upon the failure to make such record, or give such notice, the person, persons, or corporation making such

transfer shall be deemed and treated by said Commissioners, for all purposes of taxation, to be the owner of owners thereof, notwithstanding such transfer, and shall be liable for and shall pay all such taxes as may be laid on such land by said Commissioners at any time before said record is made or said notice is given; and such tax shall be a lien on such grounds.

REFERENCES, ETC.

Section 8 is a copy of Chap. L, Pub. Acts, 1886, and Sec. 2340.

Sec. 9. Said Commissioners shall, previous to the delivery of any instrument conveying the right to plant or cultivate shell-fish on any of said grounds, locate and delineate the same, or cause it to be located and delineated upon the map aforesaid, and upon receipt of said instrument of conveyance the right to use and occupy said grounds for said purposes shall be and remain in said grantee, and his legal representatives; unless it shall be forfeited by other provisions of this act; provided that any person, except such owner or such Commissioners who shall stake out or enclose any grounds in state jurisdiction for the purpose of planting or cultivating oysters therein shall be fined not more than fifty dollars.

Sec. 10. When it shall be shown to the satisfaction of said Commissioners that any natural oyster or clam bed has been designated by them to any person or persons, said Commissioners shall petition the superior court of the county having jurisdiction over said grounds to appoint a committee to inquire and report to the said court the fact as to such grounds, and said court shall in such case appoint such committee, who, after twelve days' notice to the petitioners and respondent shall hear such petition, and report the facts thereon to said court; and if it shall appear that any natural oyster or clam beds, or any part thereof, have been so designated, the said court may order that said grounds may revert to the State, after a reasonable time for the claimant of the same to remove any shell-fish he may have planted or cultivated thereon in good faith, and said court may further order that all stakes and buoys marking the same be removed, the cost in said petition to be taxed at the discretion of the court.

REFERENCES, ETC.

Section 9 is a part of Sec. 2319. The provision regarding survey of ground has been repealed and the provision for staking ground is a dead letter and both are stricken out. The last half

of the section relating to application to court and confiscation of ground is not used and its purposes are covered by the reversion of ground if taxes are not paid for five years. Sec. 2357 is re-written and forms the last part of the section.

Section 10 is a copy of Section 2324.

Sec. 11. Any Commissioner who shall knowingly grant to any person or persons a franchise as hereinbefore provided in any natural oyster or clam bed, shall be fined not less than one hundred, nor more than five hundred dollars, and if such franchise is granted the grant shall be void, and all moneys paid thereon shall be forfeited to the State; and the said Commissioners shall in no case grant to any person or persons a right to plant or cultivate shell-fish which shall interfere with any established right of fishing, and if any such grant is made the same shall be void.

Sec. 12. Any owner of grounds heretofore designated for the cultivation of oysters in the waters of Long Island Sound within the jurisdiction of said Commissioners, may surrender the same by delivery to the State of a good and sufficient deed of release of the same, duly executed and acknowledged by such owner; provided such release is made without charge or expense to the State and is approved by said Commissioners. And upon the delivery of said deed made out to the acceptance of said Commissioners, they may rebate all unpaid taxes upon the ground released.

REFERENCES, ETC.

Section 11 is a copy of Sec. 2335.

Section 12 is a copy of Sec. 2321 with a sentence added to allow taxes to be abated on surrendered ground in accordance with present practice.

Sec. 13. All questions and disputes touching the ownership, title, buoys, boundaries, ranges, extent or location of any shell-fishery grounds within the exclusive jurisdiction of the State may be referred to and settled by the Shell Fish Commissioners, who are hereby empowered, on petition of any person interested therein, to summons all parties in interest, so far as such parties may be made known to them, to appear before them at a time and place in the summons named, such summons to be signed by the Clerk of said Commissioners, and served by him or such other person as said Commmissioners may direct; whereupon, at such time and place named, or any other time and place named to

which the hearing may be from time to time adjourned, the party petitioner shall file a sworn statement of the facts as claimed by him to which an interested party may respond by filing a sworn counter-statement of the facts as claimed by him; and after hearing all the parties interested with their witnesses and counsel, said Commissioners shall make their decision in writing an soon as convenient thereafter, which decision shall be recorded in the books of record in their office, and the same shall be binding on all the parties in interest so summoned or appearing, unless an appeal shall be taken from such decision to the superior court in and for the county where the town is situated, between whose meridian lines any portion of said grounds may be, within ten days after such decision shall be filed by said Commissioners with their Clerk aforesaid, and unless such appeal shall be prosecuted to judgment and said decision reversed by said superior court. Said appeal may be taken in the same manner as appeals in civil cases from justice courts.

REFERENCES, ETC.

Section 13 is a copy of Sec. 2329.

Sec. 14. Every person filing a petition, statement, or counter-statement, as provided in the preceding section, shall, at the time of such filing deposit ten dollars with said Commissioners, who shall return to the prevailing party the sum so deposited by him, and shall retain the money so deposited by the defeated party as a forfeit to pay the expenses of the investigation, which money so retained shall be accounted for and paid to the State Treasurer for the benefit of the State.

Sec. 15. In all cases hereafter brought before said Commissioners, under the provisions of the two preceding sections the parties in interest shall pay each of said Commissioners for such services the sum of five dollars per day and expenses for every day employed by them in such hearing, and said Commissioners shall pay all sums received by them for such services to the State Treasurer, and expenses necessarily incurred in carrying out the provisions of the two preceding sections, shall be audited by the Comptroller, and paid by the Treasurer of the State.

REFERENCES, ETC.

Section 14 is a copy of the first part of Sec. 2330, but the last part applies to work that has been accomplished and is not in-

cluded. Sec. 2332 has no practical use and is not included in the draft.

Section 15 is made up of Sec. 2, Chap. CC, Pub. Acts, 1889, and Sec. 2333.

Sec. 16. All owners of shell-fish grounds lying within the exclusive jurisdiction of the State shall, on or before the first day of November, annually, deliver to the Shell Fish Commissioners a statement under oath specifying the number of lots owned by them, the location and number of acres in each lot, the number of acres in each lot cultivated, and the value thereof per acre, the number of acres in each lot uncultivated and the value thereof per acre; and printed blanks for such statements shall be prepared by said Commissioners and furnished to such owners upon application to them, or at their office; and upon the failure of any owner to deliver such sworn statement to said Commissioners at their office within the time above specified, said Commissioners shall make up such statement from the best information they may obtain, and shall add for such default ten per cent. to the valuation so made.

Sec. 17. All statements so delivered or made shall be alphabetically arranged, and said Commissioners shall equalize, if necessary, and determine the value of all the property so returned and described in said statement, which property shall be liable to taxation at the valuation so determined, including the ten per cent. for default as aforesaid; and said Commissioners are authorized and empowered to declare and lay a tax thereon, annually, at the rate of one and one-half per cent. upon such valuations, which shall be payable at the office of said Commissioners on and after the first Monday in May, annually, and if said tax is not paid on or before the first Monday in July succeeding, interest shall be added thereon at the rate of one per cent. per month from the day such tax became due and payable, until paid and said tax with interest shall be a lien upon the grounds so taxed from the time it is so laid by said Commissioners, until paid, and shall be in lieu of all other taxes on said ground.

REFERENCES, ETC.

Section 16 is practically the same as Sec. 2334.

Section 17 is the same as Sec. 2335 with the amendment contained in Sec. 4, Chap. CIV, Pub. Acts, 1895, and the first part of Sec. 2336 inserted near the end.

Sec. 18. If a tax is not paid on or before the first Monday of July the said Commissioners may make and issue their warrant for the collection thereof, with interest thereon at one per cent. per month from the day such tax became due and payable until paid, together, with the expenses of such collection, which warrant shall authorize any reputable person named therein to seize such grounds and any oysters or other shell-fish thereon, or any other property of the owner or owners thereof not exempt from execution, and to sell the same, or so much thereof as he may find necessary, at such time and place, and in such manner, and by such person as said Commissioners may direct, whereupon such sale sall be so made, and such warrant shall immediately be returned to said Commissioners by such person with all his doings endorse thereon, and he shall pay over to said Commissioners the money received upon said sale, and they shall apply the same to the payment of such tax and all the expenses thereon, including the expenses of such sale, returning any balance that may remain to such owner or owners; and all moneys received by said Commissioners in payment of taxes and interest thereon shall be accounted for and paid to the State Treasurer for the benefit of the State.

REFERENCES, ETC.

Section 18 is the same as Sec. 2336.

Sec. 19. Said Shell Fish Commissioners shall be a board of relief, and shall meet at such times and places as they shall fix, and may adjourn from time to times till they shall have completed their duties. As such board of relief, said Commissioners shall have and exercise all the power and duties now conferred by law upon boards of relief of towns.

Sec. 20. All expenses necessarily incurred in carrying out the provisions of the three preceding sections shall be audited by the Comptroller and paid by the Treasurer of the State.

Sec. 21. When the taxes on any oyster grounds, within the exclusive jurisdiction of the State, and under the control of the Shell Fish Commissioners, shall be in arrears for five consecutive years, it shall be the duty of the Clerk of Shell Fisheries to notify the owner or owners of said grounds, or their legal representatives, of the fact of said arrears, and if, within three months after the date of said notification, all arrears of taxes on said grounds are not paid, said grounds shall revert to the State; and it shall

be the further duty of the Clerk of Shell Fisheries, upon the reversion of said grounds to the State, to make out a certificate of the fact of such reversion for record upon the books of the Commission, and said grounds shall thereupon be open for application, like all other unsold oyster grounds within the exclusive jurisdiction of the State.

REFERENCES, ETC.

Section 19 is a copy of Sec. 5, Chap. CC, Pub. Acts, 1889.

Section 20 is a copy of Sec. 2338.

Section 21 is a copy of Sec. I, Chap. CL, Pub. Acts, 1895.

Sec. 22. The location and descriptions of the natural oyster beds respectively under State jurisdiction are as follows, to wit:

CORMELL REEF NATURAL BED.

The southern point of this bed is the point which is two thousand five hundred and fifty-five feet due north of a point which is one thousand nine hundred and twenty-two feet due west of the center of the tower of Great Captains Island lighthouse. The said southern point is also determined by the following sextant angles: Little Captains Island coast survey signal to Americus, 64° 27′; Americus to Mead, 84° 16′; Americus to Portchester spire (Methodist), 82° 56′. From the said southern point the eastern boundary line runs north twenty-eight degrees east, true meridian, seven hundred feet, to buoy known as 1002 in commissioners' buoy records, and determined by the following sextant angles: Little Captains Island coast survey signal to Americus, 70° 47′; Americus to Mead, 90° 03′; Mead to Great Captains Island light-house, 139° 15′. The following ranges pertain to this point: first, Daniel Lyon, Jr.'s house on with High-water rock; second, sharp top tree in woods showing above all the woods, on with dock at the Americus club house. Thence north thirteen degrees east, true meridian, one hundred and ninety feet to buoy known as 1003 in commissioners' buoy records, and determined by the following sextant angles: Little Captains Island coast survey signal to Americus, 72° 27′; Americus to Mead, 92° 00′; Mead to Great Captains Island light-house, 135° 27′. The following ranges pertain to this point: first, Methodist spire on with west end of sand beach on Calves Island; second, Rye Beach hotel on with gap or cut in

Jones' stones. Thence north sixty-six degrees west, true meridian, four hundred and thirty-five feet to buoy known as 998 in commissioners' buoy records, and determined by the following sextant angles: Little Captains Island coast survey signal to Americus, 70° 25′; Americus to Mead, 95° 43′; Mead to Great Captains Island light-house, 139° 05′. The following ranges pertain to this point: first, gap in woods on with white rock on south end of Calves island; second, clump of woods on Long Island on with west bluff of bank of Great Captains Island. Thence south fifty-one degrees and fifteen minutes west, true meridian, nine hundred and ten feet to a point determined by the following sextant angles: Little Captains Island coast survey signal to Americus, 62° 20′; Americus to Mead, 90° 14′; Americus to Portchester spire (Methodist), 88° 42′. Thence south five degrees and fifteen minutes west, true meridian, two hundred and fifteen feet to buoy known as 1023 in commissioners' buoy records, and determined by the following sextant angles: Great Captains Island light-house to Americus, 107° 42′; Americus to Calf, 110° 27′; Summer-house to Great Captains Island light-house, 107° 27′. The following ranges pertain to this point: first, barn just south of bush's wood just open to the south of barn on Bower's Island; second, south edge of stone house on with white stone near the south end of Calves Island. Thence south seventy-five degrees and twenty minutes east, true meridian, seven hundred and seventy-five feet to the point of beginning. The area comprised is fifteen acres.

REFERENCES, ETC.

Section 22 is Chap. CXVIII, Pub. Acts, 1885, as printed in Sec. 2328.

PORTCHESTER BED.

Beginning at the northern point of the bed, said point being the southeast corner of ground of Isaac Martin. The said point is known as buoy number 479 in commissioners' buoy records, and is determined by the following sextant angles: Summer-house to Calf, 131° 17′; Calf to Mead, 76° 54′; Summer-house to Great Captains Island light-house, 100° 40′; Great Captains Island light-house to Horse Neck spire, 84° 00′. The following ranges pertain to this point: first, the north side of Clifford's house opens about fifty feet west of the west side of Black Tom

rocks; second, the south side of bathing house of Edward Schell is in line with the north side of the high rock of the Black Tom rocks. (The bathing-house stands on the main shore southwest of the steamboat dock at Portchester.) From the said northern point the northern boundary line runs south sixty-five degrees and fifteen minutes west, true meridian, across the highest part of Beach rock to the shore. The point on Beach Rock is determined by the following sextant angles: Summer-house to Calf, 121° 38′; Calf to Horse Neck spire, 47° 54′; Summer-house to Great Captains Island light-house, 92° 08′. From the said northern point, the eastern boundary line runs south fifty-three degrees and thirty-five minutes east, true meridian, eight hundred and ninety feet to buoy 481, at the south corner of the ground of George W. Martin. Thence south sixty-four degrees east, true meridian, one thousand eight hundred and fifty feet, to buoy 482. This point is determined by the following ranges: first, cupola of Abendroth's house over slim cedar tree, the west one of several, standing on the mainland and near the shore; second, the south side of woods on Rye Point, in line with bottom of bluff on south end of Manursing Island. Thence south sixty-six degrees and forty-five minutes east, true meridian, eight hundred and seventy-five feet to buoy 1076, the same being the south corner of ground of George Martin and Sons. Thence south four degrees west, true meridian, six hundred and eighty feet to buoy 514, at the north corner of ground of David B. Chard. This point is determined by the following ranges: first, bluff on Lloyd's Neck on with high-water mark at west end of Great Captains Island; second, liberty cap on large white boulder at the extreme west end of Brush Island over spindle on Jones' stones. Thence south thirty-one degrees and fifty minutes west, true meridian, along last mentioned range line along ground of David B. Chard, and on public domain, one thousand eight hundred and fifteen feet. Thence north sixty-seven degrees and fifteen minutes west, true meridian, one thousand four hundred and fifteen feet, in a line passing through buoys 489 and 490, and ranging: first, south side of a large tree on hill on with two cedar trees standing at the shore and nearly in line, and also in line with north end of steamboat dock. Thence north thirty-one degrees east, true meridian, three hundred and eighty-five feet along ground owned or occu-

pied by William Maguire to buoy 510. Thence north fifty-nine degrees and twelve minutes west, true meridian, one thousand four hunded and eighty feet to Big Captains Island rock. This line ranges south chimney of Brooks' house over cedar bush stuck on the Big Captains Island rock. The said rock is known in commissioners' buoy book records as position 486. Thence north fifty-five degrees west, true meridian, one thousand seven hundred and sixty feet to position 478, the same being a hole drilled near the center of the outer rock at Bryam Point. A cedar bush stands in the hole. Thence northerly along the east bank of Bryam Point to intersect the northern boundary line of the bed. The area of this bed is two hundred and eighteen acres.

The following sextant angles are of record as determining the positions and points mentioned in the preceding description, namely:

481—Summer-house to Great Captains Island light-house, 117° 42′; Great Captains Island light-house to Horse Neck spire, 84° 30′; Great Captains Island light-house to Mayo, 82° 10′.

482—Great Captains Island light-house to Calf, 97° 31′; Calf to Summer-house, 117° 26′; Great Captains Island light-house to Mayo, 89° 07′.

1076—Great Captains Island light-house to Mayo, 91° 46′; Mayo to Summer-house, 113° 44′; Great Captains Island light-house to Calf, 116° 07′.

514—Great Captains Island light-house to Calf, 102° 47′; Calf to Summer-house, 86° 11′; Great Captains Island light-house to Rock, 66° 41′; Rock to Mead, 54° 21′.

489—Great Captains Island light-house to Calf, 69° 29′; Calf to Rye spire, 103° 09′.

490—Great Captains Island light-house to Calf, 62° 44′; Calf to Summer-house, 97° 33′.

510—Great Captains Island light-house to Calf, 62° 43′; Calf to Summer-house, 111° 43′; Great Captains Island light-house to Mead, 94° 33′; Mead to Summer-house, 79° 49′.

486—Great Captains Island light-house to Mead, 88° 50′; Mead to Summer-house, 119° 01′.

478—Summer-house to Great Captains Island light-house, 83° 00′; Great Captains Island light-house to Horse Neck spire, 70° 30′; Great Captains Island light-house to Mayo, 64° 25′.

GREAT CAPTAINS ISLAND NATURAL BED.

Beginning at the point of intersection of a line due east of the Great Captains Island light-house, with a line ranging northerly and southerly over the steeple of the Methodist church in Greenwich and the west end of the building standing near the end of the steamboat dock; thence running southerly along the last mentioned line about one thousand four hundred feet to a point of its intersection with a line ranging over a gap in the high woods which are north and east of Reuben B. Lockwood's house in old Greenwich, or Sound Beach, and low-water mark southeast of the clump on Little Captains Island. This point, known as number 521 in commissioners' buoy book, is determined by the following sextant angles; namely: Stamford light-house on Horse Neck spire, 62° 19′; Horse Neck spire to Rye spire, 91° 13′; Stamford light-house to Americus, 59° 17′; Americus to Bloomer, 59° 24′. Thence running westerly on a straight line to a point formed at the intersection of two lines, one ranging over the north side of the high part of the Rye Beach hotel and the south side of the gap in the woods on a distant hill in Rye, and the other ranging over the spire of the Second Congregational church at Greenwich and a small elm tree on the west end of Great Captains Island. This point, known in commissioners' buoy book as number 421, is determined by the following sextant angles: Little Captains Island to Calf, 67° 03′; Calf to Summer-house, 42° 39′; Stamford light-house to Mayo, 61° 27′; Mayo to Rye spire, 84° 06′. The west side of the bed follows the last-mentioned range line to the high-water line on the south side of Great Captains Island; thence easterly following said high-water line, to a point which is due east from the center of the tower of the Great Captains Island light-house; and thence due east to the point of beginning. The area of this bed is one hundred and fifty-two acres.

FIELD POINT NATURAL BED.

Beginning at a point in the commissioners' line of jurisdiction, where it is intersected by a line ranging over the steeple of the Second Congregational church at Greenwich and the extreme east end of the "marble house," formerly used as a marble factory, which stands near the steamboat dock; running thence southerly along said range line to its point of intersection known in commissioners' buoy book as number 453, with a line ranging west-

erly over the church spire at Rye, N. Y., and the south gable of the westernmost house on Calf Island. Said point is determined by the following sextant angles: Americus to Mead, 99° 20′; Mead to Great Captains Island light-house, 82° 30′; Horse Neck spire to Portchester spire, 77° to 29′; Portchester spire to Great Captains Island light-house, 93° 30′. Thence running easterly to a point known in commissioners' buoy book as number 455, formed at the intersection of two lines; one line ranging westerly over a large tree in Portchester and the center of the eastern house on Calf Island (a slim cedar tree is in the same range), and the other line ranging northerly over the steeple of the Second Congregational church at Greenwich and the west side of Black Rock, west of the Americus house. This point may be found by the following sextant angles: Americus to Mead, 90° 15′; Mead to Great Captains Island light-house, 75° to 27′; Horse Neck spire to Portchester spire, 75° 11′; Portchester spire to Great Captains Island light-house, 86° 00′. Thence running southwesterly to a point known in commissioners' buoy book as number 456, formed at the intersection of three lines: the first line ranging westerly over the northeast section of the north house on Calf Island and the north cedar tree at the shore on the east side of Calf Island; the second line ranging also westerly over the south edge of the Brooks house and the north side of the shed which stands northeast of the barns on Calf Island; and the third line ranging northerly over the steeple of the Second Congregational church at Greenwich and the flagpole on the west end of Caleb Holmes' storehouse. This point is determined by the following sextant angles: Americus to Mead, 98° 54′; Mead to Great Captains Island light-house, 03° 55′; Horse Neck spire to Portchester spire, 75° 48′ 30″; Portchester spire to Great Captains Island light-house, 103° 48′. Thence running northwesterly to a point known in commissioners' buoy book as number 457, formed at the intersection of two lines; one line ranging over Lloyd's Neck Bluff on the east side of the east clump at Little Captains Island, at about half the height of the clump, and the other line ranging over the east end of the dining-room of the Americus house and the center of the white rock at the extreme south end of Field Point. This point is determined by the following sextant angles: Little Captain commissioners' signal to Americus, 87° 27′; Americus to Mead, 128° 37′; Americus to Portchester spire, 113° 37′; Port-

chester spire to Great Captains Island light-house, 118° 46′. Thence running northerly to the line of jurisdiction between the State and town in the direction of a point, known in commissioners' buoy book as number 458, formed at the intersection of two ranged lines, one running easterly over the high part of the bluff on the north side of Little Horseshoe in Cos Cob harbor and the point where the black and white rocks on the extreme southeast end of Field Point come together; and the other line running westerly over the north side of the old Benjamin Merritt house, just clear of the cedars and the southwest end of Otter Rocks. This point is a little north of said line of jurisdiction, and is determined by the following sextant angles: Stamford light-house to Great Captains Island light-house, 87° 04′; Great Captains Island light-house to Bloomer, 107° 06′; Great Captains Island light-house to Portchester spire, 110° 57′. The northern side of this bed follows the line of jurisdiction between the State and town. The area of bed is eighty-four acres.

GREENWICH POINT NATURAL BED.

Beginning at a point at the intersection of the line of jurisdiction between State and town with a line ranging Seth Quintard's house over Ami Ferris's old house; thence running southerly on said range line to its point of intersection with a line ranging westerly over the round-topped tree in Rye and the south side of Great Captains Island at low-water; thence westerly along said last mentioned range line to its point of intersection with a line ranging about northwesterly over the steeple of the Second Congregational church at Greenwich opening west of Flat Neck woods; thence northwesterly along the last mentioned range line to where it intersects the line of jurisdiction between the State and town; thence easterly along said line to the point of beginning. The eastern line of the bed is a line which passes through two points which are determined by the following sextant angles, namely: First point, Stamford light-house to Greenwich Point, 105° 49′ 20″; Greenwich Point to Great Captains Island light-house, 52° 17′; Stamford light-house to Horse Neck spire, 99° 13′; Horse Neck spire to Great Captains Island light-house, 58° 57′. Second point, Stamford light-house to Greenwich Point, 82° 35′; Greenwich Point to Great Captains Island light-house, 63° 32′; Stamford light-house to Horse Neck spire, 88° 59′; Horse Neck

spire to Great Captains Island light-house, 57° 04′. The southern line of the bed is a line which passes through two points which are determined by the following sextant angles: First point: Stamford light-house to Horse Neck spire, 82° 38′ 30″; Horse Neck spire to Great Captains Island light-house, 55° 38′. Second point: Stamford light-house to Horse Neck spire, 84° 43′; Horse Neck spire to Great Captains Island light-house, 61° 05′; Stamford light-house to Greenwich Point, 47° 23′; Greenwich Point to Great Captains Island light-house, 98° 24′. The point last given is the southwest corner of the bed. The area comprised is four hundred and three acres.

FAIRFIELD BAR AND FAIRFIELD NATURAL BEDS.

These two beds are contiguous, and the portions thereof within State jurisdiction are as follows: Beginning at the center of the tower of the Penfield Reef light-house, and starting from this point as the southeast corner of these beds, the southern boundary line runs south eighty-one degrees and twenty-four minutes west, true meridian, eleven thousand five hundred and fifteen feet to the extreme south point of the three large flat rocks at the southern end of Sunken Island. Said point is located by the following sextant angles: Penfield Reef light-house to Episcopal spire in Fairfield, 63° 10′; Episcopal spire in Fairfield to Jennings' house, 90° 26′; thence due west twelve thousand three hundred and twenty-three feet to a rock known as "the fishing rock." Said rock is situated southerly of Farms Point, and is determined by the following sextant angles: Scott's house to Jennings' house, 38° 47′; Jennings' house to Burnham's barn, 111° 11′; Scott's house to Farm's Point, 74° 53′; thence from "the fishing rock" due north to the commissioners' line of jurisdiction; thence easterly along said line of jurisdiction to Pine Creek Point; thence still following the said line of jurisdiction to Shoal Point; thence along the Fairfield bar to a point due north of the center of the tower of the Penfield Reef light-house; thence due south to the point of beginning. The area comprised is one thousand two hundred and thirty-seven acres.

BRIDGEPORT NATURAL BED.

The part in State jurisdiction is described as follows: The southeast corner of this bed is the point which is three hundred

and sixteen feet due east of a point which is one thousand one hundred and thirty-two feet due south of the center of the tower of the Bridgeport light-house. The said southeast corner is the northeast corner of ground of David N. Armstrong. From the southeast corner the southern boundary line runs due west along ground of said Armstrong, a distance of one thousand nine hundred and thirty feet, to a point which has the following ranges: first, Black Rock light-house over the center of the woods on Wakeman's Island; second, soldiers' monument over the center of the grain elevator; thence northerly along the last-mentoined range line and along ground of Charles H. Armstrong, a distance of six hundred feet; thence south sixty-four degrees and fifty-seven minutes west, true meridian, four thousand one hundred and twenty feet along ground of said Armstrong; thence due south six hundred and sixteen feet along ground of said Armstrong to the northwest corner of ground of Wheeler Hawley; thence south sixty-four degrees and fifty-seven minutes west, true meridian, one hundred and seventy feet along ground of Charles J. Nash. (The said bearing ranges Black Rock light-house over the center of the woods on Wakeman's Island.) Thence south nine degrees west, true meridian, five hundred and eighty feet along ground of said Nash; thence south thirty-four degrees and fifty-two minutes west, true meridian, one thousand three hundred and twenty feet along ground of said Nash; thence south eighty-one degrees and forty-five minutes west, true meridian, three thousand seven hundred and twenty feet in a direct line towards the Black Rock light-house to the east shore of Fayerweather's Island at the high-water-line; thence northerly along said east shore about four hundred and fifty feet to the line of jurisdiction between the State and town; thence northeasterly along said line of jurisdiction nine thousand four hundred and twenty feet to the extreme south point of the sea wall at Seaside Park; thence southeasterly along said line of jurisdiction two thousand eight hundred and seventy-five feet; thence due south one thousand three hundred and fifty feet to the point of beginning. The area thus comprised is three hundred and thirty-four acres.

STRATFORD NATURAL BED.

Beginning at a point in the commissioners' line of jurisdiction, distant about one thousand eight hundred and thirty feet north-

easterly from the center of the tower of the new Stratford Point light-house; thence running due south to a point which is determined by the following sextant angles: "Fish" to Stratford Point light-house, 105° 47′; Stratford Point light-house to Middle Ground light-house, 114° 26′; Stratford Point light-house to Penfield Reef light-house, 45° 11′. ("Fish" is the factory chimney of the oil works at Welch's Point.) The point thus located is the southeast corner of the bed, and it may also be found by intersecting the following range lines: One range line running northerly along the edge of the roof on the easterly side of the light-house keeper's new house, near the Stratford Point light-house; the other range line running northeasterly over the southeast side or face of the old hotel on Charles Island, and a tall, prominent tree at the left side of a little gap in the woods on the northern slope of a distant hill. This gap may be found by beginning at the fish works at Welch's Point and looking northerly along the crest of hills until you pass four prominent single trees, which rise above the top of the general wood line. The four trees stand near the right hand side of the gap. At the said southeast corner, the compass bearing to the tower of the Stratford Point light-house, is northwest by west, and the distance to the same is one thousand four hundred and sixty feet; thence from said southeast corner running in a southwesterly direction a distance of twelve thousand two hundred and fifty feet to a point which is determined by the following sextant angles: Penfield Reef light-house to Middle Ground light-house, 99° 07′ 30″; Middle Ground light-house to Stratford Point light-house, 115° 27′; Stratford Point light-house to Bridgeport light-house, 97° 07′; Bridgeport light-house to Penfield Reef light-house, 48° 18′. The approximate compass bearing of this line is southwest by west three-eighths west. The terminal point of this line is the extreme south point of the bed, and is also further determined by the intersection of the following range lines: Northerly, over Ambler's house at Nichol's Farms, Trumbull, and the middle poplar of the five poplar trees near the shore at Point-no-Point, on which is termed the Lordship farm. The compass bearing of this range line is north by east. Northwesterly, over cupola of P. T. Barnum's house, at Bridgeport, and the center of the dwelling house attached to the Bridgeport light-house. Northwesterly again, over the cupola of Dr. Warner's house at Seaside Park, Bridge-

port, and the west tree of the five single trees on a ridge in the distance. The compass bearing of this range is northwest one-half north. Thence running northwesterly on a line in the direction of the spire of the Congregational church at Fairfield, a distance of thirteen thousand eight hundred and thirty feet, to its point of intersection with a line ranging northerly over the factory chimney of the Read Carpet Company, at Bridgeport, and the Soldiers' Monument at Seaside Park. Thence northerly along said last mentioned range line to ground designated to Robert E. DeForest; thence due east to southeast corner of said designation; thence due north to the commissioners' line of jurisdiction; thence easterly along said line to the point of beginning. The area comprised is three thousand and fifty-five acres.

ROTON POINT AND FISH ISLAND NATURAL BEDS.

The part in State jurisdiction is described as follows: The northeast corner is a point which is thirty-five feet due south of a copper bolt set at the extreme south end of Bell Island. Said bolt is a triangulation station and is known as "Bell Island." From said northeast corner the northern boundary line runs south eighty-one degrees and twelve minutes west along the commissioners' line of jurisdiction in the direction of the position known of record in the buoy records as 1954, a distance of five thousand eight hundred and sixty-five feet to the east line of ground of Oliver Cook. (Said east line starting from a position known of record in the buoy records as number 1882, *i. e.*, the extreme edge of Moll's Rock showing at low water, and running to position 1887, *i. e.*, the extreme east edge of Peat's rocks at low water.) Thence south twenty-three degrees and fifteen minutes west and passing through position 1887, one thousand five hundred and eighty-five feet to position 1892. (Said position 1892 being the northeast corner of rocks on Fish Island at low water.) Thence south twenty-seven degrees and forty-five minutes west seven hundred and twenty feet to buoy 1234 at the northeast corner of ground of William I. Stevens; thence south four degrees and forty-five minutes west five hundred and twenty feet, to buoy 1101 at the southeast corner of said Stevens' ground; thence north seventy-four degrees and sixteen minutes east three thousand five hundred and sixty feet to position 1900; thence north seventy-

eight degrees and seven minutes east two thousand nine hundred and fifty-five feet, to buoy 1175 at the southwest corner of Charles W. Bell; thence north twenty-seven degrees east six hundred and fifteen feet to buoy 1176; thence south seventy-three degrees east three hundred and forty feet to buoy 1466; thence north twenty-two degrees and thirty minutes east one thousand and twenty feet to the commissioners' line of jurisdiction, said bearing being in line with buoy 1873; thence north forty-three degrees and thirty minutes west along said line of jurisdiction seven hundred and sixty feet to the point of beginning. All bearings are true meridian. The area comprised is three hundred and seven acres.

The following sextant angles determine the positions and points mentioned in the preceding description, namely:

1954—Collender to Cedar Tree (Fish Island), 79° 15′; Cedar Tree (Fish Island) to Bell Island, 71° 05′; Cedar Tree (Fish Island) to Norwalk light-house, 55° 40′.

1882—Collander to Cedar Tree (Fish Island), 28° 30′; Cedar Tree (Fish Island) to Norwalk light-house, 105° 40′; Cedar Tree (Fish Island) to Norwalk Spindle, 92° 54′; Norwalk Spindle to Pike, 60° 50′.

1887—Bell Island to Centennial, 100° 20′; Centennial to Collender, 91° 19′; Norwalk Spindle to Pike, 63° 58′.

1892—Norwalk Spindle to Pike, 63° 10′; Pike to Centennial, 49° 08′; Norwalk light-house to Pike, 51° 31′.

1534—Norwalk light-house to Centennial, 86° 24′; Centennial to Collender, 110° 48′; Bell Island to Centennial, 65° 23′.

1191—Norwalk light-house to Colyer, 82° 59′; Colyer to Collender, 106° 47′; Norwalk Spindle to Bell Island, 32° 29′.

1900—Chimons to Pike, 72° 19′; Pike to Collender, 97° 55′; Tavern Island to Pike, 62° 51′.

1175—Norwalk light-house to Bell Island, 82° 41′; Bell Island to Colyer, 91° 49′; Chimons to Bell Island, 48° 23′; Bell Island to Collender, 118° 02′.

1176—Norwalk light-house to Bell Island, 96° 14′; Bell Island to Colyer, 91° 08′; Chimons to Bell Island, 55° 53′; Bell Island to Collender, 114° 07′.

1466—Chimons to Bell Island, 67° 26′; Bell Island to Centennial, 77° 54′; Norwalk light-house to Depot, 89° 10′.

1873—Chimons to Depot, 53° 41′; Depot to Centennial, 103° 07′; Chimons to Bell Island, 110° 43′.

Sec. 23. The Shell Fish Commissioners shall cause those natural or public oyster beds in the exclusive jurisdiction of this State known as the Stratford Bed, the Fish Island and Roton Point Beds, the Bridgeport Bed, and the Fairfield Bed, to be marked by buoys, which shall be known as State buoys, and by range monuments on the shore by which the lines can be relocated should any buoys be removed, and shall cause double bouys or a distinctive mark to be placed at any point on the boundary where the line changes in direction, and said buoys shall be maintained by the State. No buoys shall be so set in lines, so run as to include within the natural or public beds any private or designated grounds; provided, that said Commissioners shall not expend for said purpose during any one year, a sum exceeding one-half the amount received for licenses to work on the natural or public beds of the State during the preceding year. Any person injurying or removing such range monuments, or displacing such State buoys, shall be fined not more than fifty dollars, or imprisoned not more than thirty days, or both.

Sec. 24. No person shall take or gather oysters from any natural oyster bed in the exclusive jurisdiction of the State in any boat or vessel unless said boat or vessel shall be duly licensed and numbered in the manner hereinafter provided. Any person, desiring to use any boat or vessel for such purpose, may make written application to the Clerk of Shell Fisheries, stating the name, owner, rig, general description, tonnage, and place where any such boat or vessel is owned, and said Clerk of Shell Fisheries shall issue to the owner of such boat or vessel a license to take and gather oysters from the natural oyster beds in the exclusive jurisdiction of the State for one year, from the twentieth day of July in each year, unless sooner revoked, upon the payment of two dollars for a vessel or boat of under five tons, and for a vessel or boat exceeding five tons fifty cents for each additional ton, custom-house measurement; provided, that before such license is granted the owner or master shall prove to the satisfaction of said Clerk of Shell Fisheries that such boat or vessel is legally entitled to work on the public beds of the State, and that the captain and crew of such boat or vessel have been residents of this State for one year next preceding the date of such license, and that the dredges and other contrivances do not weight more than

thirty pounds, as provided in Sec. 25 of this act. Every boat or vessel so licensed shall while at work upon any of the natural oyster beds of the State, display upon both sides of the peak of her mainsail or on a standard set in the stern of said boat if it has no sail, the number of such license, in black figures, not less than one foot in length, and the coat of arms of Connecticut painted or stenciled upon cloth of suitable and uniform material, to be attached or stitched to the sail. The Clerk of Shell Fisheries shall furnish such numbers and coat of arms when the license is granted. When any boat or vessel so licensed shall be sold to other parties the license shall be transferred at the office of the Clerk of Shell Fisheries. Any license granted to any person who, during the period for which said license is granted, remove from the State, shall be revoked.

REFERENCES, ETC.

Section 23 combines the provisions of Sections 1, 2 and 3 of Chap. CCXXV, Pub. Acts, 1895.

Section 24 is a copy of Sec. 1, Chap. CLXXI, Pub. Acts, 1893, with Sec. 2 as amended by Chap. XX, Pub. Acts, 1895, and by Chap. CCLXII. Pub. Acts, 1895. The last sentence of Sec. 2 has been erased as a legal opinion has decided that boats owned out of the State could be licensed and such boats have been licensed since the law went into effect.

EXPLANATION.

The special appropriation for the two years, October 1st, 1897 —September 30th, 1899, override the law and in several cases these appropriations change the existing laws very materially especially in Sec. 23.

Sec. 25. No license shall be granted to any boat under the provisions of the preceding section unless the employer, captain and crew are at the time and have been for one year next preceding actual inhabitants or residents of this State, and no persons shall use on said boat while at work on any of the natural oyster beds any dredge or other contrivance weighing more than thirty pounds, exclusive of the bag or net.

Sec. 26. No boat or vessel so licensed shall use on the natural oyster beds of this State any naphtha, vapor, steam or electric engine, or device for hoisting or operating dredges, or other devices for gathering oysters, except by hand power, provided,

however, that this section shall not be so constructed as to prevent the use of steamboats in taking up or dredging for oysters on private designated grounds in any such waters by the owners thereof, or to prevent the use of steam excavators for deepening the water in places where there are no natural oyster or clam beds, or where such beds have not existed within ten years, by digging or removing material, permission to use such excavators being first given by the Shell-Fish Commissioners which permission shall not be given until after a public notice of at least two weeks of the time and place they will hear all parties desiring to be heard upon such application, where notice shall be posted in the office of the town clerk of the town where such grounds are located.

REFERENCES, ETC.

Section 25 combines Section 2403 as amended by Chap. XXXVI, Pub. Acts 1897, and Section 2404.

Section 26 combines Section 3, Chap. CLXXI, Pub. Acts 1893, and Section 2405.

Sec. 27. Any person using any boat or vessel in violation of any of the provisions of the three preceding sections or who shall use any device or number not furnished by the Clerk of Shell Fisheries for such boat or vessel, or not bearing the coat of arms of the State, shall be liable to a fine of ten dollars for each day that said boat or vessel shall be so unlawfully used, and any boat or vessel which shall be found being used contrary to the provisions of this act, shall be liable to the penalties provided in Section 32 of this act.

Sec. 28. The Shell Fish Commissioners shall, annually, appoint some person to be Inspector of Natural Oyster Beds, who shall hold office until his successor is appointed and qualified. It shall be his duty to detect and prosecute offenses against the shell-fishery laws relating to the natural oyster beds within the exclusive jurisdiction of the State and to the Housatonic river, and for such purpose he shall have the power to go upon any boat or vessel that is being employed upon said beds, or in said river, and may examine any dredges, tongs, or other tools or machinery used thereon, and he shall have the same powers as other officers to arrest for any violation of said laws, and shall be entitled to the same fees as other officers for making such arrests, in addition to the compensation hereinafter provided.

He shall at his own expense, maintain a suitable boat or vessel to be used in the discharge of the duties herein imposed, and shall at all times during such period of the year as said Board may prescribe, have said boat or vessel in readiness to investigate any alleged violation of said laws.

REFERENCES, ETC.

Section 27 combines Section 4 of above act and Section 2406.

Sec. 29. It shall be the duty of said Inspector of Natural Oyster Beds to report to the Shell Fish Commissioners the failure of any person to comply with the provisions of Sections 24 and 26 of this act, and upon the conviction of any person of the offense of dredging upon the natural oyster beds within State jurisdiction, without a license therefor, as therein provided, such person so convicted shall be disqualified from receiving a license to gather oysters from said natural oyster beds within the exclusive jurisdiction of the State, for the remainder of the year for which a license might have been granted, and upon the conviction of any person to whom a license was granted, of any violation of the provisions of this act, the license so granted to him shall be revoked. Said Inspector of Natural Oyster Beds shall also report to the Shell Fish Commissioners any displacement of the buoys provided for in Section 23 of this act.

Sec. 30. Said Inspector of Natural Oyster Beds shall be paid a salary of four hundred dollars per annum, by the Shell Fish Commissioners, or a proportionate amount thereof for such period as he shall hold said office, and said Shell Fish Commissioners may remove him for cause, and appoint his successor for the remainder of said term.

REFERENCES, ETC.

Section 28, 29 and 30 combine all the provisions of Chap. CXI, Pub. Acts, 1895.

Sec. 31. The Shell Fish Commissioners shall appoint and employ five or more persons to act as Oyster Police, who shall detect and prosecute any violations of the Statutes relating to shell-fisheries upon the private oyster grounds in this State; and shall have all the powers provided in Section 32 of this act. They shall perform such other duties in the enforcement of this act as may be directed by the Shell Fish Commissioners. They shall receive such compensation as said Commissioners may

deem just and reasonable, but not exceeding the sum of three dollars per day to each person. Said Commissioners may also hire or charter such boats or vessels as may be necessary for such oyster police; provided that the total expenditure, in any one year, shall not exceed one-third the taxes upon oyster ground paid by the oyster growers to the State in the preceeding year.

Sec. 32. All sheriffs, deputy sheriffs, constables, oyster police, and inspectors of natural oyster beds, shall, and any other person may, seize any boat or vessel illegally used in dredging, with its tackle, apparel and furniture, wherever found, within one year thereafter; and shall forthwith give notice thereof to two justices of the peace, or, if in New Haven county, or in Fairfield county, to any city court of the county where the seizure was made, which authority shall forthwith order reasonable notice to be given to the person who is in possession of the property seized, or to the owner thereof, if known, of the time and place of trial; and shall at the time appointed determine whether such property was used contrary to law, and if found to have been so used, shall order it to be sold in such manner as said authority shall direct; and the avails thereof, after deducting all costs and charges which said authority may allow, shall be paid half to the person who made the seizure and half to the town where the offense was committed. If such property be found not to be used contrary to law, then all costs and charges which said authority may allow shall be paid by the State in the manner provided for the payment of costs in criminal causes coming to the superior court from an inferior court. The authority before which any such cause is pending shall order the release of the property seized, upon the filing of a sufficient bond to the person making the seizure, with surety, conditioned for the return of said property, on demand, if the same shall finally be ordered sold.

REFERENCES, ETC.

Section 31 combines all the provisions of Chap. CIV, Pub. Acts 1895.

Section 32 is a copy of Section 2400 as amended by Chap. CXXII with the words "Inspectors of natural oyster beds" added to first part.

Sec. 33. When there shall be found on board any boat or vessel, illegally used under the provisions of this chapter, any dredge

and shells or shell fish, in any of the waters of this State, it shall be prima facie evidence that said boat or vessel was used contrary to the provisions of this chapter.

Sec. 34. Every person on board any such boat or vessel, who shall prevent or obstruct any person from entering and seizing it, shall be fined not more than one hundred dollars, or imprisoned not more than six months, or both.

REFERENCES, ETC.

Section 33 is a copy of Section 2401.

Section 34 is a copy of Section 2402.

Sec. 35. Every person about to engage in removing mud or other material, from any town in this State bordering on Long Island Sound, south of which oyster grounds are owned by private individuals, which grounds are in the State jurisdiction as provided in section 5 of this act, shall notify the Shell Fish Commissioners by a written or printed notice, delivered to said Commissioners at this office in New Haven, stating the time when such work will be commenced and the name of the boat or boats to be employed. Within a reasonable time after the receipt of said notice said Commissioners shall designate and buoy out places off the respective town where such deposits shall be made. No person shall deposit any material in any place in Long Island Sound except in places that have been so designated and buoyed out by said Commissioners or within a radius of five miles from Southwest Ledge lighthouse off New Haven Harbor or in any of the waters opposite Branford, unless such material is to be used for making oyster beds. No person, during the night season between sunset and sunrise, shall deposit or assist in depositing any substance except oyster shells and other materials used for making oyster beds, in any of the waters of Long Island Sound.

Sec. 36. All persons desiring to dump dredge material on the private oyster beds of the State, from bottom or side dumping scows, shall first make application to the Shell Fish Commissioners, designating the material and the location where it is proposed to dump the same, and it shall be the duty of said Commissioners to notify adjoining owners, that they may protest, if material or place is not suitable. Any person violating the provisions of this section shall be fined not more than fifty nor less than seven dollars for each offense.

REFERENCES, ETC.

Section 35 combines the provisions of Sections 2383, 2385, 2388 and 2389.

Section 36 is the same as Chap. CCLXX, Pub. Acts 1895.

Sec. 37. Said Commissioners shall appoint one or more suitable persons who shall be known as mud dumping inspectors, whose duty it shall be to accompany every boat, when it is employed in towing or carrying mud or other material in any of the territory mentioned in the two preceding sections, to see that such mud or other material is properly dumped, and to report to said Commissioners any violation of law in respect to such dumping. No person in charge of or employed upon such boat shall interfere with such inspector in the discharge of his duty or refuse to permit him to enter and remain upon said boat while it is so employed. Said inspectors shall receive a sum not exceeding two and one-half dollars per day for such services, to be paid by said Commissioners and charged as other expenses if said material is taken on to the public dump, but to be paid by the owners of the oyster ground on which the material is dumped if not taken to the public dump. Said inspectors shall make sworn returns to the office of said Commissioners of all material taken out in boats on which they act as inspector, and of the place where dumped, and no bill for services shall be paid until said sworn returns are on file in said office.

Sec. 38. No person shall dump mud or other material except that used in making oyster beds, on any of the ground of this State located and designated as oyster grounds, or injure any such enclosure or the oysters planted or cultivated thereon.

REFERENCES, ETC.

Section 37 combines the provisions of Sections 2382 and 2384.

Section 38 combines Sections 2387 and 2398.

Sec. 39. No person shall wilfully injure any oyster enclosure belonging to another and legally designated, marked out and enclosed or remove any buoys or stakes used to mark out any oyster grounds, or shall take any oysters or shells from any grounds, lawfully planted or cultivated in any waters or any oysters being on any place duly designated for the planting or cultivation of oysters, without permission from the owner, or injure the oysters planted and cultivated thereon, or deposited or assist

in depositing any star fish, drills or periwinkle in any of the navagable waters of this State.

Sec. 40. No person shall rake, gather or collect any shells or shell-fish upon any oyster ground designated to any person or persons unless said ground has at each corner thereof a buoy or stake visible at high water with the name or initials of the owner of said ground plainly marked or painted thereon or upon a tag attached to the top of such buoy or stake. No person shall between sunset and sunrise take or collect any shells or shell-fish from any place in the navagable waters of this State.

Sec. 41. Any person violating any of the provisions of this act for which no special fine is provided, shall be fined not more than five hundred dollars, and if a boat was used in the commission of the offense, the boat or boats shall be liable to seizure and may be proceeded against in the same manner as is provided in Section 32 of this act.

REFERENCES, ETC.

Section 39 combines Sections 2397-2358.

Section 40 combines Sections 2372, 2399-2373.

Section 41 combines Section 2391 and the penalty clauses of a number of sections.

Sec. 42. When oysters have been planted or cultivated on any ground legally designated and recorded for such purpose, and there be any doubt as to which of the adjoining towns has jurisdiction of the same, any offense against the provisions of this may be prosecuted in either of the three towns nearest to the place where the offense is committed.

Sec. 43. This act shall not apply to the construction of breakwaters, docks or any work ordered by the United States Government.

Sec. 44. The Shell Fish Commissioners may appoint two or more persons in each town bordering on Long Island Sound to be shell-fish wardens, who shall assist in detecting and prosecuting offenses against the shell-fishery laws, shall be paid the same fees allowed to grand jurors in criminal cases, shall have the same powers as other officers to arrest for the violation of said shell-fishery laws, and shall hold office until their respective successors are appointed and qualified.

Sec. 45. The Shell Fish Commissioners are authorized and

empowered to hire and take upon leases not exceeding a term of ten years, in the name and behalf of the State, any such plot or plots of ground within the State as they may deem necessary for the constructing, erecting, setting, maintaining, and protecting of signals, beacons, bound-stones, posts, or buoys to be used in designing, locating, surveying, or mapping any shell-fish grounds within State jurisdiction.

REFERENCES, ETC.

Section 42 is a copy of Section 2360.

Section 43 is a copy of Section 2392.

Section 44 is a copy of Section 2311.

Section 45 is a copy of Section 2412.

Sec. 46. Every person who shall willfully injure or remove any signal, beacon, bound-stone, post, or buoy, or any part, appurtenance, or enclosure thereof, which has been or shall be erected, constructed, or set by said Commissioners, or by their order, on the land or water of this State, for the purpose of designating, locating, surveying, or mapping, any shell-fish grounds, shall be fined not less than seven nor more than one hundred dollars, or imprisoned not less than ten nor more than ninety days, or both.

Sec. 47. Executions shall be issued in accordance with Sections 1170 and 1190, and estates settled according to Section 602 of General Statutes.

Sec. 48. The executor or executors of the will and the administrator or administrators of the estate of any deceased person who, at the time of his or her death, was the owner of oyster ground within the State jurisdiction, shall, within two months after becoming qualified to act in such fiduciary capacity, lodge with the Shell Fish Commissioners a certificate, under his, her, or their hands, stating the fact of the death of such decedent, the place where he or she last dwelt, the date of his or her death, the amount and location of oyster ground owned by said decedent, and whether he or she left a will; which certificate shall be recorded in the records of the Shell Fish Commissioners. Any executor or administrator neglecting or refusing to perform the duties hereby imposed shall forfeit twenty-five dollars to the State.

REFERENCES, ETC.

Section 46 is a copy of Section 2413.

Section 47 refers to other Sections in the Statutes.

Section 48 is a copy of Chap. XXXII, Pub. Acts, 1897.

Sec. 49. Sections 2310, 2311, 2315, 2316, 2317, 2318, 2319, 2320, 2321, 2322, 2323, 2324, 2325, 2328, 2329, 2330, 2331, 2332, 2333, 2334, 2335, 2336, 2338, 2339, 2340, 2357, 2358, 2382, 2383, 2384, 2385, 2386, 2387, 2388, 2389, 2390, 2391, 2392, 2412, 2413 of the General Statutes and Chapter CC of Public Acts of 1889, Chapters CX, CLXXI and CCXLV of Public Acts of 1893, Chapters XX, CIV, CXI, CL, CCXXV, CCXLVII, CCLXII, CCLXX, and CCXCI of Public Acts 1895, Chapters XXXII, XXXVI, and CXXII of Public Acts 1897, and all other acts and parts of acts inconsistent herewith are hereby repealed.

